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ANNUAL REPORT

OF THE

OHIO ACADEMY OF SCIENCE

Fiftieth Meeting

1940

THE OHIO ACADEMY OF SCIENCE

Organized 1891 Incorporated 1892

Affiliated with the American Association for the Advancement of Science

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Stockdale, Paris B.
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REPORT OF THE FIFTIETH ANNUAL MEETING OF THE OHIO ACADEMY OF SCIENCE

In line with a resolution and plan adopted by the Academy at its annual meeting in 1937 (the 47th), the meeting in 1940 was devoted almost exclusively to the celebration of the "Golden Anniversary." This anniversary was held on May 9, 10 and 11, at Ohio State University and was generally conceded to be an outstanding event in the history of science in Ohio. To do justice to the event as a whole, to the officers and members who labored so long and so hard to bring the event to a happy fruition, and to the many notable scientists who contributed so generously of their time and talent to the success of the celebration, would require a very sizable volume. The determination on the part of the officers and members of the Academy to publish just such a volume, one that will be a memorial worthy of the event and the participants, in the not too distant future is very strong, and our hopes are very high that some way of bringing this about will be found.

In the meantime, it seems fitting that a very brief report of the meeting should be made and printed in the usual manner. Obviously many of the usual features of the annual meeting of the Academy had to be omitted or modified. This applies particularly to the fine sectional meetings and programs that usually form such a vital part of the annual meeting. Instead, the scientific portion of program took the form of symposia of great and general interest participated in by the most eminent scientists of the country, both home and abroad.

For example, on Friday morning (May 10), three concurrent symposia were discussed by the most eminent authorities: (1) A Symposium on *Hearing*, discussed by Dr. R. H. Stetson of Oberlin College and Dr. E. A. Culler of the University of Illinois; (2) A Symposium on the *Basic Factors in Conservation*, discussed by Dr. Guy W. Conrey of the Ohio Agricultural Experiment Station, by Dr. Frank J. Wright of Denison University, and by Dr. E. N. Transeau, Ohio State University; (3) A Symposium on *Radiation and the Cancer Problem*, ably discussed by Dr. E. U. Condon of the Westinghouse Research Laboratories, by Dr. Isadore Lampe, of the University Hospital, University of Michigan, and by Dr. Francis Carter Wood, of Saint Luke's Hospital, New York.

Friday afternoon was devoted to one great general meeting in the University Chapel at which three outstanding addresses were made: (1) "Forests on a Changing Earth" by Dr. R. W. Chaney, of the University of California; (2) "Application of Airplane Photography to Geographic Studies" by Dr. John L. Rich of the University of Cincinnati; and (3) "Industry and Science" by Dr. Charles F. Kettering of the General Motors Research Corporation.

Then on Saturday forenoon four concurrent symposia: (1) A Symposium on the Nervous System, discussed by Dr. Herbert S. Gasser, Director of the Rockefeller Institute, by Dr. R. W. Gerard, of the University of Chicago, and by Dr. John F. Fulton, of Yale University; (2) A Chemical-Physical Program, discussed by Dr. Edward Mack of the Battelle Memorial Institute, Dr. M. S. Newman, Ohio State University, and by Dr. H. S. Booth, Western Reserve University; (3) A Genetics-Speciation Program, discussed by Dr. Laurence H. Snyder, of Ohio State University, by Dr. Warren P. Spencer, of the College of Wooster, and by Dr. David C. Rife, Ohio State University; and (4) A Botanical Program in which Dr. A. E. Waller of Ohio State University, Dr. J. H. Gourley, of Ohio Agricultural Experiment Station, Dr. Paul B. Sears of Oberlin College and Dr. E. Lucy Braun participated.

The meeting really began on Thursday evening, May 9, with a very large general gathering in the University Chapel. At this first meeting the Governor of Ohio, the Honorable John W. Bricker, extended the greetings of the State of Ohio to the assembled scientists, and President Howard L. Bevis of the Ohio State University welcomed the Academy and its friends to the University, to which President William Lloyd Evans responded for the Academy. Following these exchanges of greetings, the audience was treated to a masterly address on "Sound Patterns," wonderfully illustrated, by Dr. Harvey Fletcher of the Research Staff of the Bell Telephone Company.

As usual, Friday evening was given over to the annual banquet, always a most interesting event. The banquet was held in the Hall of Mirrors at the Deshler-Wallick Hotel, with a capacity attendance, and was presided over by President-Emeritus William McPherson. The event of the annual banquet is always the Presidential Address. Doctor Evans chose for his topic, "A Present-Day Examination of the Postulates of John Dalton." He made the story or history of the atom as

revealed by the ever increasing scientific light of knowledge through the years most interesting and informing.

Just preceding the Presidential Address, Dr. James P. Porter of Ohio University gave a very full history of the Ohio Academy of Science during the fifty years of its existence.

Under the new constitution the only opportunity the Academy as a whole has to consider the business affairs of the Academy is at the annual banquet. It was therefore necessary to hear brief reports from officers and committees, to hold the annual election and transact any other business deemed proper. These reports will be published in full in the memorial volume (if and when published) and only a rèsumè given at this time.

The Nominating Committee nominated and the Academy elected the following officers for the ensuing year:

President.....Stephen R. Williams, Oxford
Secretary.....William H. Alexander, Columbus
Treasurer.....Edward S. Thomas, Columbus
Joint Administrative Board, O. J. S....A. W. Lindsey, Granville; James R. Patrick, Athens
Trustee Research Fund.....Paul B. Sears, Oberlin
Committee on Conservation.....T. H. Langlois, Columbus; J. D. Sayre, Wooster; D. M. DeLong, Columbus

The Committee on Membership reported the election of 127 new members during the year and the restoration of three. Fellowship in the Academy was bestowed by the Council on the following persons, viz.:

John G. Albright.....Case School of Applied Science
Harvey Clayton Brill.....Miami University
G. E. Coghill.....Gainesville, Fla.
Elizabeth Eleanor Coyle.....College of Wooster
Oliver Daniel Diller.....Ohio Agricultural Experiment Station
William Clarence Ebaugh.....Denison University
Paul E. Fields.....Ohio Wesleyan University
Alfred Benjamin Garrett.....Ohio State University
Roy I. Grady.....College of Wooster
Frank Alexander Hartman.....Ohio State University
James Arthur Herrick.....Kent State University
Charles D. Hodgman.....Case School of Applied Science
Harvey Everett Huber.....Ohio Northern University
Howard Wilfred Johnson.....Bureau of Plant Industry, U. S. D. A.
Charles F. Kettering.....General Motors Research Corporation
Harold P. Knauss.....Ohio State University
Alfred Lande.....Ohio State University
Robert Donald Lewis.....Ohio State University
Warren C. Miller.....Bedford High School, Bedford, Ohio

M'Della Moon.....Bluffton College
Dwight Munson Moore.....University of Arkansas
Christian Nusbaum.....Case School of Applied Science
M. L. Pool.....Ohio State University
Milton Porter Puterbaugh.....Ashland College
Harmon A. Runnels.....Ohio Agricultural Experiment Station
Robert S. Shankland.....Case School of Applied Science
Julius F. Stone.....Ohio State University
Clarence Egbert Taft.....Ohio State University
Milton B. Trautman.....Franz Stone Laboratory
Richard Thurman Wareham.....Ohio State University
Abraham H. Wiebe.....Tennessee Valley Authority
John H. Wolfe.....Ohio State University

The meeting was characterized not only by an unusually rich program, excellent in every way, but by at least two other notable features: (1) The number and quality of the exhibits, assembled and arranged by the Committee on Exhibits under the enthusiastic and resourceful leadership of Dr. Glenn W. Blaydes of Ohio State University. Note that at the time of the printing of the program there were ninety-nine *centralized* and forty *fixed* exhibits ready for the opening day of the centennial; others came in later. These exhibits in themselves showed marked cleverness and ingenuity on the part of the exhibitors; (2) One of if not *the* most significant forward step made at this annual meeting was the organization of a *Junior Academy Section* of the Ohio Academy of Science, largely due to the persistent, intelligent, skillful, enthusiastic leadership of Dr. Charles W. Jarvis of Ohio Wesleyan University, materially aided in the final steps by the inspirational talks and helpful suggestions of Dr. Otis W. Caldwell of the American Association for the Advancement of Science. Special credit should also be given to Mr. Orville Linebrink of the Columbus Schools for his untiring aid in interesting other schools in the Junior Academy. We understand there are now some ninety science clubs, members of the Junior Academy and these are well distributed over the State. We wish we had the space and the ability to describe adequately some of these papers, demonstrations and exhibits put on by these youngsters; they would do credit to any group. Take as an example the "Dissecting of a Pig Embryo," a demonstration put on by four girls from the Walnut Hills High School of Cincinnati under the sponsorship of Miss Etta Elberg; or, the demonstration by two boys from the New Philadelphia High School entitled "Experiments Using Dry Ice," sponsored by Miss Leila E. Helmick. Both performed in a masterly manner.

There were other features, of course, and other items of

interest in the various reports but lack of space forbids further review, except that we must give a small part of the Treasurer's report that you may have some idea as to the financial affairs of the Academy. The report covers the year ending December 31, 1939, and was duly audited. See following.

As to the report of the Trustees of the Research Fund it may be sufficient to say that it shows grants paid $198.52, with a balance in the checking account of $193.93, and assets (bonds, stock, etc.) to the value of $1,737.50.

So much then for the Fiftieth Anniversary! May the One Hundredth Anniversary witness even greater things!

WILLIAM H. ALEXANDER, *Secretary.*

Report of the Treasurer

Dear Mr. Alexander:

I enclose a financial statement of the condition of the Ohio Academy of Science as of December 31, 1939. The books have been audited and the opinion of the auditor is herewith attached.

Cordially yours,
Eugene Van Cleef, *Treasurer.*

BALANCE SHEET AS AT DECEMBER 31, 1939

Assets

CURRENT EXPENSE FUND:		
Cash in bank—Current		$ 27.37
Cash in bank—Semi-Centennial Celebration		100.00
Undeposited Cash		2.50
Total cash		$ 129.87
Dues receivable 1938	$ 75.00	
Dues receivable 1939	170.00	
Total Dues receivable		245.00
Bonds—Consolidated Federal Farm Loan 3% 1945–55		1,300.00
Total assets current expense fund		$1,674.87
RESEARCH FUND:		
Cash on deposit	$ 193.93	
Banc Ohio Securities Company Stock (cost)	437.50	
Bonds—Fort Hayes Hotel—Columbus, Ohio (cost)	1,300.00	
Total assets research fund		1,931.43
Total assets		$3,606.30

Liabilities, Deferred Credits and Net Worth

LIABILITIES:		
None.		
DEFERRED CREDITS TO INCOME:		
Reserve for uncollected dues 1938 and 1939		$ 245.00
1940 dues collected in 1939		37.50
Total deferred credits to income		$ 282.50

NET WORTH:		
Ohio Academy of Science—		
Current expense fund—surplus	$1,292.37	
Research fund—surplus	1,931.43	
Semi-Centennial Celebration—surplus	100.00	
Total surplus (schedule 1)		3,323.80
Total liabilities, reserves and net worth		$3,606.30

ANALYSIS OF CHANGES IN SURPLUS DECEMBER 31, 1939

Surplus, December 31, 1938		$3,414.98
Deduct:		
Decrease in surplus—current expense fund	$ 65.59	
Decrease in surplus—research fund	125.59	
Total deductions		191.18
Surplus—Current and Research Funds		$3,223.80
Surplus—Semi-Centennial Celebration		100.00
Total Surplus, December 31, 1939		$3,323.80

STATEMENT OF INCOME AND EXPENSE FOR THE YEAR ENDING DECEMBER 31, 1939

INCOME:		
Dues for the year 1939		$1,202.50
Grants for research		150.00
Sale of publications		7.65
Interest on bonds		39.00
Total income		$1,399.15
OPERATING EXPENSES:		
Speakers	$ 25.00	
Clerical assistance	20.70	
Postage and telegraph	85.75	
Office supplies and expenses	25.55	
Expenses of officers to meetings	62.70	
Printing:		
Proceedings, Ohio Journal of Science	$138.25	
Other	155.87	
Total printing	294.12	
Subscriptions, Ohio Journal of Science	675.00	
Research grants	150.00	
Secretary's honorarium	100.00	
Safety Deposit box rent	3.30	
Bond treasurer	5.00	
Auditing expense	15.00	
Bank charges	9.62	
Total operating expenses		1,471.74
Net operating deficit for the year 1939		$ 72.59
OTHER INCOME:		
Dues collected for prior years:		
1937	$ 2.50	
1938	90.00	
Total other income	$ 92.50	
OTHER EXPENSE:		
1938 subscriptions, Journal of Science	85.50	
Net other income		7.00
Net deficit for the year		$ 65.59

STORAGE TESTS WITH SEED CORN

J. D. SAYRE*

INTRODUCTION

Many tests have been made on the longevity of seed corn. Those described in this paper, however, differ from most others, because the seeds were stored in large test tubes with a glass seal to be absolutely sure that there was no exchange of gases between the seeds and the outside air. In most tests of longevity no attempt has been made to preclude exchange of gases. One of the objects of this test was to study the effect of different gases on the longevity of the seeds; thus it was necessary to have a perfect seal to maintain the gas content.

EXPERIMENTAL PROCEDURE

Large culture tubes, 1 by 8 inches, were used as containers for the seed. Each tube held about 100 seeds of Clarage seed corn. The procedure in sealing the tubes was rather simple. A bottleneck was drawn in the tube near the open end in a hot flame, and an opening left just large enough for a single seed to pass through easily. After the tubes were filled with seeds, a wad of asbestos fiber was placed on top of the lot and the tubes were sealed in a small hot flame. This was done quickly so that there was no danger of injuring the seed from the heat.

The tubes were filled with gas by placing a small glass tube through a two-hole rubber stopper to the bottom of the tube and forcing gas through the seeds. Carbon dioxide, oxygen, and nitrogen were used. The carbon dioxide was generated from hydrochloric acid and limestone and washed twice with sulphuric acid to adjust the vapor pressure to that of the seeds. The gas was forced through the seeds for 10 minutes. The outlet tubes were then closed with pinchcocks, and the sample was left overnight. The next day carbon dioxide was forced through the seeds for 10 minutes more and the tube was sealed while the gas was still passing into the tube. The same procedure was used in filling the tubes with nitrogen except that the nitrogen was washed twice with pyrogallic acid to remove oxygen.

Gas many times the volume of the tube was passed through each in order to remove as much of the air as possible. It is questionable whether the last trace of air could be removed without some other treatment, such as heating or a high vacuum, but these treatments could not be used because of danger of injury to the seeds. Oxygen was

*In co-operation with the Department of Agronomy, Ohio Agricultural Experiment Station, and the Division of Cereal Crops and Diseases, Bureau of Plant Industry, U. S. Department of Agriculture.

passed through the seeds for 5 minutes and the tubes were sealed while it was entering the tube. This treatment would not displace all the air in the tube but would raise the oxygen pressure very high.

The seeds were stored at several different temperatures. It was necessary to use available facilities for this work; thus, the rooms where they were stored were not at constant temperatures. Some were stored in the soil biology culture room, which is maintained at a very high temperature, somewhere around 30° C. Others were kept in a basement seed storage room whose temperature is somewhat lower. Two rooms in the animal industry refrigerator were used, one in which apples are stored, +3° C. to +4° C., and which never freezes, and another which is kept below freezing at all times, —2° C. to —9° C. The other room used was the low-temperature room in the Agronomy Service Building, which is kept at —25° C. but which may be changed at times for other experiments for a week or so to as high as —7° C.

Results

The results of these tests are shown in Tables I and II.

TABLE I

SUMMARY OF PERCENTAGE GERMINATION OF CORN SEEDS OF DIFFERENT MOISTURE CONTENT STORED AT ROOM TEMPERATURES AND BELOW 0° C.

PERCENT MOISTURE	½ YEAR		2 YEARS		4 YEARS		6 YEARS	
	Room	—0°C.	Room	—0°C.	Room	—0°C.	Room	—0°C.
7.5	92	95	89	87	96	88	80	88
11.0	98	90	91	96	82	88	81	95
14.6	88	95	0	82	69	86	15	80
18.2	0	73	0	34	0	51	0	13

Significant difference = 8.

TABLE II

SUMMARY OF PERCENTAGE GERMINATION OF CORN SEEDS SEALED WITH DIFFERENT GASES AND STORED AT THREE TEMPERATURES

GAS CONTENT	1 YEAR			3 YEARS			5 YEARS		
	30° C.	3° C.	—25°C.	30° C.	3° C.	—25°C.	30° C.	3° C.	—25°C.
Air	82	91	93	76	94	92	39	90	92
Carbon dioxide	84	87	91	84	92	92	39	95	91
Oxygen	78	84	91	0	84	94	0	90	91
Nitrogen	89	91	93	27	90	80	21	92	86
Open to air	84	93	84	88	92	86	66	83	90

Significant difference = 13.

It is rather hard to evaluate these results because any direct comparison with checks was not made. It is possible, however, to compare results when moisture content, time of storage, and storage temperature were in all combinations with each other, and when gas content, time of storage, and temperature of storage were combined similarily. A statistical analysis of these data as outlined by Brandt (2) was carried out. Since the values of germination are given in percentages and since they vary from 0 to 98, they have been changed to values of angles of equal information, as suggested by Bliss (1). The factorial analysis was carried out on the values and the error obtained converted back to percentages. The homogeneous variances of the interactions were considered as the error term in determining the significance of the main comparisons. These results show that moisture content, temperature of storage, and time of storage were the only significant main comparisons.

A summary of the main comparisons is given on page 5, and a careful examination of these results shows that there was no difference between the two low moisture contents but that great differences occurred at the higher contents. The germination of the seeds was much better at the low storage temperatures, but here also no difference was noted between those stored at —25° C. and at about 0° C.

Germination has gradually decreased with time in both lots of seed. The most interesting results are shown by the seeds sealed in atmospheres of single gases. There was no difference in germination of the seeds stored in carbon dioxide and in air, but significant decreases were shown by those sealed in nitrogen and in oxygen. From a theoretical standpoint, the seeds stored in oxygen, especially at a high temperature, should die because of increased respiration, and those without oxygen should die because of lack of respiration. This was not so, however, because those in carbon dioxide showed no decrease in germination when compared with air, whereas those sealed in nitrogen were injured some. Our idea of the respiration requirement for viable seeds may not be correct. In fact, it may be that respiration is a detriment to the longevity of seeds and that any external or environmental condition which will decrease respiration will lengthen the life of the seeds.

These data do not show that seeds were benefited by storage in carbon dioxide when compared with air, but neither do they show that they were injured. Beneficial results were obtained by Kondo (3) and Kondo and Okamura (4), (5), with rice seeds in Japan. Rice seeds which died in 7 months when stored in the air germinated 98 per cent after 4 years when stored in airtight containers with either air or carbon dioxide.

These experiments have not run long enough yet to see whether any benefit results from carbon dioxide storage, because the seeds stored in air are still germinating very high. The experiment is being continued and enough tubes are still available to continue the test for 10 to 15 years, as they will be tested for germination only every 2 or 3 years.

Summary of main comparisons of Table I:

Percentage moisture	*Percentage germination*
7.5	89
11.0	90
14.6	64
18.2	21
Temperature of storage	
Room	55
—0° C.	78
Years of storage	
½	79
2	60
4	70
6	57

Summary of main comparisons of Table II:

Gas content	*Percentage germination*
Air	83
Carbon dioxide	84
Oxygen	68
Nitrogen	74
Open to air	85
Temperature of storage	
+30° C.	57
+ 3° C.	90
25° C.	90
Years of storage	
1	88
3	78
5	71

CONCLUSIONS

Seed corn was not injured by sealing it in glass test tubes with air or carbon dioxide, but it was injured by sealing it in oxygen or nitrogen.

Low-temperature storage of seed corn benefited germination greatly, for seed which remained viable for only 6 months at a high temperature still grew after 6 years of storage at a low temperature.

Low moisture content, as has been known for years, is necessary for proper storage of seed corn.

LITERATURE CITED

(1) **Bliss, C. I.** 1938. The transformation of percentages for use in the analysis of variance. Ohio Jour. Soc. 38: 9–13, No. 1.

(2) **Brandt, A. E.** 1937. Factorial design. Jour. Amer. Soc. Agr. 29: 658–667. No. 8.

(3) **Kondo, Mantaro.** 1926. The storage of rice and change of its physical properties during this period. Ber. Ohara Inst. landw. Forsch. 3 (2): 153–175.

(4) **Kondo, Mantaro,** and **T. Okamura.** 1929. On the effect of airtight and carbon dioxide upon the storage of rice. Ber. Ohara Inst. landw. Forsch. 4 (1): 1-18.

(5) **Kondo, Mantaro,** and **T. Okamura.** 1930. Germination power, analyses and vitamin-B of hulled rice stored during 4 years either airtight or in carbon dioxide. Ber. Ohara Inst. landw. Forsch. 4 (3): 343–347. pl. 28.

Photographs

Elementary Photography in one volume offers an amateur photographer a complete and concise publication on the art and science of making pictures. The information presented is well organized, illustrated and expressed in simple language which can be readily understood by anyone having had high school training or its equivalent. The following are some of the twenty-four interesting chapters; historical background, elementary photographic optics, aberrations in lenses, camera parts and accessories, cameras and camera testing, film sensitivity and exposure, development of negatives, fixing and washing negatives, contact printing, photography of colored objects, photography of moving objects, photography by artificial light, negative troubles, reduction and intensification, projecting printing, composition, projection control, finishing the print, toning prints, natural color photography, lantern slides and transparences, etc.

As an amateur photographer the writer has derived considerable practical knowledge from the contents of the various chapters. If photographers will put into practice the many suggestions made in the various chapters, few, if any, mistakes would occur in amateur picture making.—*Alvah Peterson.*

Elementary Photography, by Gilford G. Quarles. VII + 350 pp., 83 figs. New York, the McGraw-Hill Book Co., 1940. $3.00.

Snedecor's Statistical Methods—Revised

This textbook of statistics, though written primarily for the biologist, is commonly turned to by workers in many other fields who wish to read what is perhaps the fullest account now available of the small sample methods of R. A. Fisher and others. Its author has probably had more experience in the practical application and teaching of these methods than any other person in this country. His textbook, based on that experience, has established several features of presentation as standard in statistics manuals designed for the biologist—use of but little mathematical formulation, lengthy discussion of worked examples, and emphasis upon experimental design and its implifications in statistical analysis.

The revised edition features no changes and but few additions to the former chapters. These new sections deal with (1) rates and percentages and their comparison with regression coefficients, (2) the treatment of percentages in the analysis of variance and other difficulties arising from correlation between mean and variance, (3) the treatment of data involving disproportionate subclass frequencies and modifications of the randomized block experiment, and (4) methods of multiple covariance embracing four or more variables.—*C. W. Cotterman.*

Statistical Methods, by George W. Snedecor. xiii+388 pp. Ames, Iowa, the Collegiate Press, Inc. Revised, 1938. $3.75.

THE MICROSCOPIC FLORA AND FAUNA OF TREE HOLES*

JAMES B. LACKEY
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Stream Pollution Investigations Station
Cincinnati, Ohio

There are few if any natural environments on this earth without their inhabitants. This applies either to mammals or protistan organisms; the snowfields and the hot springs have algal populations, and the most acid streams may support a rich microscopic life.

In 1936, the writer was investigating the breeding of mosquitoes in North Alabama. In an old limestone sink whose shallow central pond was occupied by a grove of Tupelo gum (*Nyssa aquatica*) some twenty tree or stump holes were found in an area of about an acre. Most of these contained water, and various ones of them were breeding places for six species of mosquitoes. Because one of these mosquitoes, *Aedes thibaulti* Dyar and Knab, is relatively rare, and practically nothing was known of its breeding habits, a careful study was made of the flora and fauna of these tree and stump holes, (1). Since then, additional tree holes in Ohio have been investigated and their interesting inhabitants studied.

Tree holes that contain water are rare. In the spring, or after a long rainy spell, many will be partly filled with water, but most frequently they will either be filled with dirt and debris, or else the wood is too porous to hold water. Occasionally one will be found which is in effect a permanent pool. With reference to their contained water they may be grouped roughly as those in the tops of living stumps, those in crotches or in the tops of protruding limbs or knots, and those in the sides of trees or limbs. The first two types may catch considerable rain water, but the last usually gets only small amounts of water which runs down the side of the tree.

Holes so far studied, with few exceptions, have contained rain water, that is, have been free from contamination by surface ground water. But their fluid is rarely clear; either enough

*Prepared for presentation at meeting of Ohio Academy of Science, Cincinnati, Ohio, April 14, 1939.

extracted material is picked up in running down the tree trunk, or else the debris and rotting wood in the hole provides enough so that a brown to black color obtains. Suspended materials are rare; the few determinations made of dissolved oxygen have shown variable amounts, but usually a high percentage of saturation. Light fluctuates with the size of the hole opening. Chemical analyses have not been made, beyond determinations for tannates and hydrogen ion concentration. Often a rather "sour" smell has been noted, and it was anticipated from this and because of suspected tannic acid that the pH would be on the acid side. However, hydrogen ion concentrations lower than pH 5.8 were not found, and in a few cases slight alkalinities obtained. For these latter, the strong odors indicated the presence of putrefactive processes yielding amines. Temperatures tended toward uniformity, that is, warmer in winter than surface ground waters and decidedly lower in summer. No macroscopic animals except insect larvae and mites have been found in any of the holes so far examined. In a few, weeds had sprouted and some contained moss.

This report covers observations on 26 tree holes, all in living trees and distributed as follows: Tupelo gum, 13; Black gum, 1; American elm, 3; Maple, 3; White oak, 2; Blackjack oak, 1; Red oak, 1; Sycamore, 1; and Sweetgum, 1. In addition, four tree holes containing water were examined and no living protozoa were found. In Table No. 1 are tabulated the data observed. Material from one of these latter subsequently developed a thriving culture of *Polytoma uvella* Ehrenberg. No observations were made on material from the remaining three. Three of the tree holes were periodically flooded by water from the pond in which the Tupelo gums were growing, and it is probable that when the Little Miami River is excessively high, the hole in the Sycamore is flooded.

Entrances to the holes varied from about eight inches in diameter to about one-half inch. One hole which contained water whenever visited, was about 20 inches deep, and two inches in internal diameter, with an opening about ¾ inch in diameter. It usually had about 8 inches of water and an inch of debris on the bottom.

About 140 species of algae and protozoa were recovered from these 30 holes. Since most of the holes were visited but once and since cultures from them usually developed additional species under laboratory conditions, it seems probable that a

much larger list of organisms could be compiled. The hole which gave the greatest number of species was Number 3, which showed 63 species. This hole was periodically flooded, but its organisms were more abundant than in the pond, and many of them were not common to the pond. On one occasion its water was deep brown, due to enormous numbers of *Trachelomonas reticulata* Klebs. It contained such species as *Chrysococcus rufescens* Klebs, *Cryptochrysis commutata* Pascher, *Chroomonas acuta* Utermohl, *Euglena mutabilis* Schmitz, *Trachelomonas rugulosa* Stein, *Phacus hispidula* (Eichw.) Lemm., *Cryptoglena pigra* Ehrenb., *Astasia Klebsii*, Lemm., *Menoidium tortuosum* Stokes, and *Trigonomonas compressa* Klebs. These are forms which the writer has not found to be widespread in natural bodies of water. There was also a species of Trachelomonas and one of Menoidium not referable to described species. On the other hand, there were forms which were very common to decaying submerged vegetation, as *Chilomonas paramecium* Ehrenberg, and such cosmopolitan forms as *Cyclidium glaucoma* O. F. M.

The large species list for this particular hole might be accounted for by the chances for frequent entry of water from the pond. But the development therein, in large numbers, of forms not common to, or not observed in the pond at all, argues for the existence of specific microclimatic conditions in the tree hole favorable for such organisms. That this is the case is further borne out by other tree holes. Holes Numbers 10 and 12 had 16 and 34 species respectively, and were so high that only rain water could trickle in. Hole Number 10 was the breeding place for four species of mosquitoes, so it is surprising that its list of organisms comprises even 16 species. Its organisms were not unusual, but most of the Chlamydomonas and Chlorogonium in it were colorless or nearly so, and in a large population of *Elepharisma undulans* Stein, the pink color was either completely gone or partly so. Hole Number 12, with 34 listed species showed some unusual forms as *Acinetactis mirabilis* Stokes, about whose validity Pascher (2) is perhaps dubious, and *Dactylochlamys pisciformis* Lauterborn. Green flagellates were scarce in this hole, but it contained *Phacus triqueter* (Ehrenb) Dujardin—and they were all colorless or nearly so! The existence of these colorless, but apparently thriving forms of normally green flagellates is further evidence for specific microclimatic factors.

A comparison of the organisms in all holes shows a strong tendency to recur. It has been stated elsewhere (3) that only very few protozoa or flagellates might be reasonably expected in a random sample of a natural water, as a stagnant pool, or quiet spot close to a river bank. If we take the entire 30 holes

TABLE I

THE LOCATION OF 26 TREE HOLES INVESTIGATED FOR MICROSCOPIC LIFE, SHOWING LOCATION, KIND OF TREE, HYDROGEN ION CONCENTRATION WHEN OBSERVED, AND LISTING THOSE SPECIES WHICH OCCURRED IN FOUR OR MORE OF THE HOLES

Hole No.	Location	Kind of Tree	pH	No. Species	*Oxytricha* sp.	*Halteria grandinella*	*Metopus* sp.	*Vorticella* sp.	*Distigma proteus*	*Menoidium incurvum*	*Colpoda aspera*	*Oicomonas* sp.	*Menoidium* sp.	*Chilodonella uncinatus*	*Cnetochilum margaritaceum*	*Cyclidium glaucoma*	*Astasia inflata*	*Chlamydomonas* sp.	*Bodo globosus*	*Heteramitus crassa*	*Polytoma uvella*	*Trachelomonas volvocina*
1	Alabama	White Oak		11	x		x	x	x								x					
2	"	Blackjack Oak		2								x		x								
3	"	Tupelo Gum	6.0	61	x	x	x	x	x	x		x	x	x		x	x	x		x		x
4	"	" "		3																	x	
5	"	" "		1								x										
6	"	" "	6.2	13	x	x		x							x						x	
7	"	" "	6.0	6				x							x		x					
8	"	" "		2						x												
9	"	" "		10			x		x	x										x		
10	"	Black Gum	6.1	16	x	x					x											
11	"	Tupelo Gum		4											x			x				
12	"	" "	6.0	35	x	x	x	x	x	x	x	x	x	x		x			x	x		x
13	"	" "	5.8	8			x	x														x
14	"	" "		12	x					x						x				x		x
15	"	" "	6.0	6		x		x		x			x									
16	"	Sweet Gum		35	x																	
17	"	Tupelo Gum	6.1	8		x			x									x	x			
18	"	White Oak		2					x				x	x	x	x	x	x	x		x	
19	Ohio	Maple	7.0	9					x		x											
20	"	Maple		4				x			x											
21	"	American Elm	7.2	1							x	x										
22	"	" "	7.2	6															x		x	
23	Kentucky	Red Oak		6																		
24	Ohio	American Elm	7.1	1																		
25	"	Sycamore	7.1	27			x	x														
26	"	Maple	7.1	1																		

examined for this study, some of the organisms occur with a relatively high frequency. This tendency is shown in Table I. Table II lists all the protozoa and algae found in the 26 holes containing living organisms. While the percentage of occurrence

in samples is not strikingly large, it is nevertheless decided, and is further corroboration of some sameness in these habitats.

The water in beech holes (Fagus sylvatica) was studied by von Brandt (4) and his findings indicate that the environment might be restrictive. He listed only six protozoa from tree holes, but Mayer (5) in a "large number" of beech holes found 34 additional species, 14 of which are included in our list. His list and ours contain many organisms characteristic of waters rich in organic contaminants.

It is interesting to speculate on how these forms first entered tree holes which now have no connection with ground water. Upward growth of the hole may be postulated in a few cases. Upward migration of some forms in the film of water along the bark in wet seasons may also be taken into account. Some of the forms are those which Unger (6) and others have shown to be found on vegetation in the form of cysts. But for others, cysts are as yet unknown, and these could hardly be transported to the tree holes by winds or animals. Perhaps a combination of methods is the easiest way to account for entrance. A few high tree holes were investigated but none had any water in them.

It is worth noting that algae, exclusive of the flagellated forms, were largely absent from these situations. Pleurococcus was probably the most frequent, but despite the diffuse light present in some of the situations, Protococcales were almost wholly lacking, only a few diatoms were seen, and no blue green algae were recorded. It may be inferred that there was too much organic matter present for the development of most algae, since several species of algae were found in the Tupelo gum pond, and at least some of the holes admitted enough light for chlorophyll bearers.

Altogether the collection of organisms studied herein is interesting because it exhibits a tendency to be an environmental group; because of its unusual forms; because of the tendency for some of the green flagellates to lose their chlorophyll and assume a saprophytic existence; and because of the evidence which it may offer for microclimatic factors in these small environmental niches.

TABLE II

List of All Organisms Identified in Twenty-six Tree Holes

BACILLARIEAE
- Pennales
  - Naviculineae
    - Navicula sp.

Chrysophyceae
- *Chrysococcus rufescens*

CRYPTOPHYCEAE
- *Chilomonas oblonga*
- *Chilomonas paramecium*
- *Chroomonas acuta*
- *Cryptochrysis commutata*
- *Cryptomonas erosa*
- *Cryptomonas ovata*
- *Cyathomonas truncata*

CHLOROPHYCEAE
- Volvocales
  - *Chlamydomonas* sp. 1
  - *Chlamydomonas* sp. 2
  - *Chlamydomonas* sp. 3 colorless
  - *Chlorogonium euchlora*
  - *Chlorogonium elongatum*
  - *Chlorogonium* sp. colorless
  - *Polytoma uvella*
  - *Polytomella citri*
- Ulrotrichales
  - *Protococcus viridis*
  - *Sphaeroplea* sp.
  - *Ulothrix zonata*
  - Unidentified algal filaments

EUGLENOPHYCEAE
- Euglenaceae
  - *Cryptoglena pigra*
  - *Euglena acutissimum*
  - *Euglena gracilis*
  - *Euglena gracilis* (?) colorless
  - *Euglena mutabilis*
  - *Euglena pisciformis*
  - *Euglena polymorpha*
  - *Euglena tripteris*
  - *Euglena viridis*
  - *Lepocinclis ovum*
  - *Phacus hispidula*
  - *Phacus longicauda*
  - *Phacus pyrum*
  - *Phacus Stokesii*
  - *Phacus triqueter*
  - *Phacus* sp., colorless
  - *Trachelomonas euchlora*
  - *Trachelomonas hispida*
  - *Trachelomonas intermedia*
  - *Trachelomonas reticulata*
  - *Trachelomonas rugulosa*
  - *Trachelomonas verrucosa*
  - *Trachelomonas volvocina*
  - *Trachelomonas* sp.
- Astasiaceae
  - *Astasia Dangeardi*
  - *Astasia inflata*
  - *Astasia Klebsii*
  - *Astasia* sp.
  - *Distigma proteus*
  - *Menoidium incurvum*
  - *Menoidium tortuosum*
  - *Menoidium* sp.
- Peranemaceae
  - *Anisonema ovale*
  - *Entosiphon ovatum*
  - *Entosiphon sulcatum*
  - *Heteronema acus*
  - *Notosolenus orbicularis*
  - *Peranema granulifera*
  - *Peranema ovalis*
  - *Peranema trichophorum*
  - *Petalomonas Steinii*
  - *Scytomonas pusilla*
  - Unidentified flagellates—several species

MASTIGOPHORA
- Pantostomatinae
  - *Acinetactis mirabilis*
  - *Bodopsis* sp.
  - *Cercobodo crassicauda*
  - *Cercobodo longicauda*
  - *Mastigamoeba reptans*

PROTOMASTIGINAE
- Oicomonadaceae
  - *Oicomonas obliqua*
  - *Oicomonas ocellata*
  - *Oicomonas sociabilis*
  - *Oicomonas Steinii*
  - *Oicomonas* sp.
- Craspedomonadaceae
  - *Monosiga ovata*
- Monadaceae
  - *Monas minima*
  - *Monas vivipara*
  - *Monas vulgaris*
- Bodonaceae
  - *Bodo angustus*
  - *Bodo globosus*
  - *Bodo lens*
  - *Pleuromonas jaculans*
- Tetramitaceae
  - *Tetramitus pyriformis*
- Distomatinae
  - *Hexamitus crassus*
  - *Trepomonas agilis*
  - *Trepomonas rotans*
  - *Trigonomonas compressa*

SARCODINA
- Actinopoda
  - *Acanthocystis aculeata*
  - *Actinophrys sol*
  - *Heterophrys myriapoda*

TABLE II (*Continued*)

Rhizopoda
Proteomyxa
Nuclearia simplex
Amoebaea
Arcella vulgaris
Amoeba radiosa
Amoeba tachypodia (?)
Amoeba sp. 1
Amoeba sp. 2
Centropyxis aculeata
Cochliopodium bilimbosum
Difflugia globosa
Difflugia pyriformis
Euglypha alveolata
Hartmanella hyalina
Trinema lineare
Vahlkampfia albida
Vahlkampfia guttula
Vahlkampfia limax

Infusoria
Ciliata
Holotrichida
Chilodonella uncinatus
Cinetochilum margaritaceum
Colpidium colpoda
Colpoda aspera
Cyclidium sp.
Cyrtolophosis mucicola
Dactylochlamys pisciformis
Drepanomonas revoluta
Drepanomonas sphagni
Frontonia acuminata
Holophrya discolor
Lagnus simplex
Lionotus fasciola
Microthorax sulcatus
Nassula aurea
Spathidium spathula
Heterotrichida
Blepharisma undulans
Metopus sigmoides
Metopus sp.
Saprodinium sp.
Oligotrichida
Halteria grandinella
Strombidium sp.
Hypotrichida
Aspidisca costata
Holosticha sp.
Oxytricha fallax
Oxytricha sp.
Stylonichia pustulata
Uroleptus sp.
Peritrichida
Opercularia sp.
Pyxidium sp.
Vorticella spp.
Unidentified ciliates, several species

SUMMARY SHOWING DISTRIBUTION

Bacillarieae	1	Infusoria	
Chrysophyceae	1	Holotrichida	16
Cryptophyceae	71	Heterotrichida	4
Chlorophyceae		Oligotrichida	2
Volvocales	8	Hypotrichida	6
Ulotrichales	5	Peritrichida	3
Euglenophyceae	42	Flagellata	81
Pantastomatinae	5	Ciliata	31
Protomastiginae	14	Sarcodina	19
Distomatinae	4	Others	6
Sarcodina			
Actinopoda	3		
Rhizopoda	16		137

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THE SOIL AS AN ECOLOGICAL FACTOR IN THE ABUNDANCE OF AQUATIC CHIRONOMID LARVAE

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INTRODUCTION

In recent years much attention has been given to the restocking of our lakes, rivers and streams with fish. Along with this restocking program there has been an intensive study of the food cycle of the fish. These studies have shown that chironomid larvae are very important in the food cycle of the game fish. Since the larvae of the Chironomidae are so important, a study of the factors influencing their abundance should be considered along with the restocking program.

Most species of aquatic chironomid larvae in pools are found burrowing in the river bottom soil to a depth of 2 inches. They are also found in decaying leaves which are mixed with the soil. Since the chironomid larvae are found in these conditions, the writer believes the following points should be considered in order to determine if the soil is an important factor in the abundance of chironomid larvae.

1. Type of soil
2. Organic matter content.
3. pH of the soil.
4. Nitrate content of the soil.

The author wishes to express his gratitude to Dr. D. M. DeLong for his excellent advice and interest during the working of this problem.

Many thanks are also due Mr. E. L. Wickliff of the Ohio Division of Conservation who, not only suggested this problem, but made it possible by furnishing the necessary equipment and transportation.

LITERATURE REVIEWED

Sullivan (1929) states that abundant chironomid larvae are found in all kinds of habitats. He did not give a description of the various types of habitats found or the number of chironomid found in each. There was no indication as to how many chironomid larvae should be considered as "abundant."

Jewell (1922) states that plenty of chironomid larvae were found but again there is no indication as to how many should be considered as "plenty." She states that no burrowing ephemerids were found in an acid stream but there were any numbers of chironomids. She states that the pH is a limiting factor for the burrowing mayfly nymphs but does not affect the chironomids.

Krecker (1933) gives a definite count of chironomid larvae per square yard and at the same time considers the type of soil as an important factor. In his study he found 60 chironomids per square yard of sand and only 20 in clay. Since this study was carried on in Lake Erie, its results cannot be compared with those in a stream except that it shows the type of bottom soil is important in the abundance of chironomid larvae.

Stehr and Branson (1938) made a number of population studies on sandy riffles and sandy pools. Their average mean count per square yard for February in a sandy riffle was 0 while the average mean count in a sandy pool was so small that it was not recorded. This paper shows that sand is not considered very productive as far as chironomid larvae are concerned.

Gersbacher (1937) in his very excellent paper on the development of stream bottom communities, states that in sand very little life can exist. According to him, the highest count of chironomids that could exist in his studies was 33.8 per square yard.

In this paper he states that as soon as algae and other detritus, which provide food and hiding places for chironomid larvae, starts accumulation, a count of 250 per square yard was considered low in many of these areas. This seems to show that there is a correlation between organic content and abundance of chironomids.

In mud bottom communities he found as high as 120 chironomids per square yard, but, if the pool is stable for the burrowing Mayflies, *Hexagenia*, will start migrating in with a corresponding decrease in the chironomid population. Silt and an accumulation of detritus is necessary for the burrowing mayfly nymphs.

PROCEDURE

The winter quarter was selected as the time in which to carry on the field work for the following reasons: First, the population

is more constant throughout the winter than the spring, summer and fall months. This is due to the fact that there is no emergence of chironomid larvae. Secondly, the larvae that hatched late in the fall would be large enough to be easily seen and handled. Finally, the larvae would remain more or less constant in size through the winter months because of the low metabolic rate which exists during low temperatures.

Blacklick Creek in Franklin County, Ohio, was selected as the stream in which to do most of the field work. However, a few samples were taken from Big Walnut Creek, Alum Creek and Olentangy River. Not as many samples were taken as the writer desired because of the flood conditions which sometimes made collecting impossible.

The soil samples were taken by the Peterson trap, which is one of the standard instruments for population studies of aquatic insects. As soon as a sample was obtained, it was placed in a 40 mesh net and as much soil as possible was washed out. The remaining material was then placed in a labeled bucket in which it was taken to a laboratory. There the larvae were picked out and counted. Finally the insects were placed in a 4 per cent solution of formaldehyde.

Observations show that the greatest depth the chironomids burrow is 2 inches. The mayfly nymphs, *Hexagenia*, burrow to a depth of 1¾ to 2 inches. Each sample was composed of a composite of 4 hand trowel samples which were taken around the Peterson samples at a distance of 1 foot. The composite sample was placed in a half pint jar and conveyed to a laboratory where it was put in a cold air cabinet and kept at a temperature of 2° C. in order to prevent bacterial growth until the time of testing. Because the Peterson trap cannot be used in a rubble riffle, all samples were taken in pools. They were obtained at a water depth of 2¼ to 3 feet.

The soil samples at the time of analyzing were dried in an oven at a temperature of 50° C. The following standard methods were used in analyzing the soil:

1. Glass electrode for pH.
2. Phenol disulphonic acid for nitrates.
3. Pipette method for soil types.
4. Chromic acid digestion method for content of organic matter.

The basis used for classification of soils was as follows:

Soil Particles	*Diam. in mm.*
Clay	.002 or less
Silt	.002—.05
Sand	.05—2.0
Gravel	above 2.0

Soil textures were defined as follows:

A. Soils containing up to 20 per cent silt and clay.
   1. Sand.....19 per cent or less silt and clay.

B. Soils containing 20 per cent to 30 per cent silt and clay.
   1. Sandy loam.....20 per cent or more fine gravel; coarse and medium sand.
   2. Fine sandy loam...30 per cent or more fine sand; 25 per cent or less gravel; coarse and medium sand.
   3. Sandy clay.....20 per cent or more silt.

C. Soils containing 50 per cent or more silt and clay.
   1. Loam.....20 per cent or less clay; 50 per cent or less silt.
   2. Silt soil.....20 per cent or less clay; 50 per cent or more silt.
   3. Clay loam.....20 to 30 per cent clay; 50 per cent or less silt.
   4. Silty clay loam.....20 to 30 per cent clay; 50 per cent or more silt.
   5. Clay.....30 per cent or more clay.

Gersbacher (1937) states that the total population of specific type in river bottom pools remain constant. When mayfly nymphs migrate in a pool there is a corresponding decrease in the number of chironomids. The total population was the number of chironomids plus the chironomids equivalent of the mayfly nymphs. The equivalent was determined by the amount of water displaced by the mayfly nymphs and chironomids. Results show that 20 chironomids displaced the same amount of water as one mayfly.

DISCUSSION OF RESULTS

The analysis of each sample for soil texture, pH, per cent of organic content and the chironomid population is shown in Table I. The tests for available nitrates are not listed because Nos. 6, 18 and 20 showed possible traces. Therefore, available nitrates in the soil is not a factor in fresh water streams, because

as shown in Table I they do not influence the chironomid population at all.

It is interesting to note in Table I that the pH of the soil samples varied from 7.3 to 8.5. This shows a very narrow range of 1.2. Since the range is so narrow, no conclusion can be drawn although Jewell (1922) states that the pH has no influence as a factor in the abundance of chironomids.

TABLE I

THE ANALYSIS OF EACH SAMPLE FOR SOIL TEXTURE, pH, PERCENT OF ORGANIC CONTENT AND THE CHIRONOMID POPULATION

Sample	Soil Type	pH	Percent Organic Content	Chironomids per sq. yd.
1	Sand	7.7	0	1,375
2	Silt-loam	8.2	1.40	1,727
3	Sandy-loam	7.6	1.37	256
4	Sand	7.6	0.29	1,738
5	Loam	7.6	1.75	5,379
6	Sandy-clay	7.7	2.74	1,762
7	Sandy-loam	7.9	1.46	2,783
8	Loam	7.6	1.98	517
9	Sandy-clay	7.6	1.62	605
10	Clay-loam	7.5	1.33	3,014
11	Clay-loam	7.3	2.39	9,933
12	Sand	7.6	0.89	132
13	Clay-loam	7.7	2.23	3,140
14	Sand	7.9	0	539
15	Sandy-clay	7.7	1.08	572
16	Sandy-clay	7.7	1.64	4,169
17	Sandy-loam	8.2	0.89	979
18	Clay-loam	7.9	3.49	946
19	Clay-loam	7.8	3.60	6,638
20	Loam	7.7	2.86	2,475
21	Sandy-clay	7.7	1.59	6,116
22	Sandy-loam	8.1	0.40	4,665
23	Sand	8.5	0.23	649

In Table II the samples of each type of soil are averaged for per cent of organic content, pH, and the chironomid population.

The lowest average population of chironomids was 387 in sand. The finer the texture of the soil, the more abundant the chironomids. The finest of these soils, the clay-loam, contained an average count of 4,723. This shows that there were approximately seven times as many chironomids in the clay-loam as in the sand. This agrees with Gersbacher (1937), who also found approximately seven times as many in the mud, which was the finest type of soil, as in the sand.

Sullivan (1929) stated that abundant chironomids were found in all types of habitats. Table II shows that the number of chironomids vary greatly with the different types of soil. This disagrees with Sullivan in that their abundance is determined by the type of soil in the pools which the chironomids habitat.

TABLE II

The Average Percent of Organic Content, pH, and the Chironomid Population for Each Type of Soil

Soil Type	pH	Percent Organic Content	Chironomids per sq. yd.
Sand	7.8	0.22	387
Sandy-loam	8.0	1.03	2,176
Sandy-clay	7.7	1.74	2,843
Silt-loam*	8.2	1.40	1,727
Loam	7.8	2.19	2,790
Clay-loam	7.6	2.61	4,723

*Since only one sample was taken, it is disregarded in the general conclusions. However, it is very interesting as a comparison.

As the percentage of organic content increases, the population of chironomids does likewise. In the silt-loam type there is a drop in the organic content and of the population count. However, this can only be considered an interesting observation, since only one sample was obtained in that type of soil. Gersbacher (1937) states that as soon as algae and other detritus accumulate in sand, there is an increase in population. Table II shows that there is a definite correlation between the organic content of the soil and the population of Chironomidae. Therefore it can be stated that the organic content is a factor, which is correlated with the soil type, in the abundance of chironomid population.

The pH in Table II ranges from 7.6 to 8.2. The average range was 0.6. As previously stated, the range is so small that it cannot be considered as a factor.

In Table III the average of the soil types, organic content, and the total population, (which is the chironomid population plus the chironomids equivalent of the *Hexagenia*), are compared.

Gersbacher (1937) states that when conditions are suitable for *Hexagenia* nymphs, we have a migration into the area of *Hexagenia* nymphs with a decrease in the chironomid popula-

tion. Considering Table III, we see that as the texture of the soil increases in fineness, with a corresponding increase in percentage of organic content, there is also an increase in the total population until the soil texture reaches the finest of the loam type. The loam type of soil has a total population of 5,543 which is 37 more than the clay-loam type. It appears after a certain number of chironomids (approximately 5,000 inhabit an area, the area must be considered a limiting factor if soil type and percentage of organic content are suitable.

TABLE III

The Average Percent of Organic Content and Total Population of Each Soil Type

Soil Type	Percent Organic Content	Chironomids
Sand	0.22	867
Sandy-loam	1.03	3,024
Sandy-clay	1.74	3,875
Silt-loam	1.40	1,727
Loam	2.19	5,543
Clay-loam	2.41	5,406

CONCLUSIONS

Soil type is a factor in the abundance of chironomids.

The pH is not a factor in the fresh water streams studied.

There were very few available nitrates in the soil.

The texture of the soil is important as a factor in the abundance of chironomids.

The organic matter content is also an important factor.

Area may be a limiting factor when soil texture and organic matter content are not.

This study shows that soil texture and organic matter content as well as area are important enough to warrant further study.

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ADDITIONS TO THE REVISED CATALOGUE OF OHIO VASCULAR PLANTS. VIII*

CLYDE H. JONES

Since the report of a year ago on the additions to the Ohio State Herbarium, we have received a collection of approximately 375 vascular plants, collected and identified in 1840 by the eminent Ohio botanist, William S. Sullivant. This excellently prepared and preserved collection is very valuable from a historical point of view, since many of the plants have not been collected in the state since that time. This probably indicates that these plants have been destroyed by farming, grazing, fire, disease, or insects.

During the past year we have been very fortunate in securing the technical advise of a number of taxonomists who are specialists in some of the more difficult groups. Numerous changes in the nomenclature and identification will be noted in this year's list.

The amateur botanists throughout the state have contributed their usual large number of interesting and valuable plant finds. One of the outstanding collections of the year is a collection of 1485 specimens donated by Robert and William Goslin. These plants were collected in Fairfield County, and although this county has been one of the favorite collecting grounds of Ohio botanists for the past one hundred years, many new and interesting distribution records are coming to light. Another carefully prepared and identified collection, consisting of 586 specimens, was donated by Don M. Brown. These plants were collected in Stark and neighboring counties, and although the collection has not been checked in its entirety, it promises to be one of great value, since most of the plants were collected near the northern boundary of the unglaciated plateau region of the state where very little collecting has been done in the past. Another valuable collection of plants from the sand dune, fossil beach, prairie, and swamp forest complex of Wood and Henry Counties was donated by R. E. Shanks. This collection has contributed a number of new and interesting range extensions.

An entire new set of species distribution maps of the vascular

*Papers from the Department of Botany, The Ohio State University, No. 427.

flora of Ohio has just been completed, and investigators can now ascertain distribution records without direct examination of the harbarium specimens. A loose-leaf index of all of the reported Ohio species accompanies this set of maps.

A series of twelve papers, dealing with Ohio floristics, is in the process of preparation, and with their completion our knowledge of the distribution of vegetation in the various physiographic regions and ecological habitats of the state should be much more complete.

The following list of additions represent new county or state records, or distribution changes resulting from critical determinations and nomenclatorial changes.

1.1. *Botrychium engelmanni* Prantl. Engelmann's Addertongue. Minera Springs, E. Lucy Braun. 1932. Lynx Prairie, Robert B. Gordon. 1935. Buzzard's Roost, Clyde H. Jones. 1937. All stations are in Adams County.

5. *Botrychium obliquum* Muhl. Oblique Grape-fern. Damascus Twp., Henry Co. R. E. Shanks.

6. *Botrychium dissectum* Spreng. Cutleaf Grape-fern. Washington Twp., Henry Co. R. E. Shanks.

7. *Botrychium virginianum* (L.) Sw. Virginia Grape-fern. Damascus Twp., Henry Co. R. E. Shanks.

14. *Phegopteris hexagonoptera* (Mx.) Fee. Broad Beech-fern. Damascus Twp., Henry Co., and Freedom Twp., Wood Co. R. E. Shanks.

16. *Adiantum pedatum* L. Maidenhair-fern. Henry Twp., Wood Co. R. E. Shanks.

17. *Pteris aquilina* L. Common Bracken. Burton, Geauga Co. C. A. Dambach.

25a. Change to *Asplenosorus ebenoides* Wherry. We do not have a specimen of this interesting hybrid in the State Herbarium. It is reported to have been collected in Hocking County a number of years ago and from Washinton and Lawrence Counties during the past year. Collectors in the plateau counties should be on the lookout for this fern wherever the parents, *Asplenium platyneuron* and *Camptosorus rhizophyllus*, occur in close proximity.

30. *Athyrium angustum* (Willd.) Presl. Upland Lady-fern. Damascus Twp., Henry Co., and Henry Twp., Wood Co. R. E. Shanks.

32. *Camptosorus rhizophyllus* (L.) Link. Walking-fern. Wayne Twp., Tuscarawas Co. Don M. Brown. Athens Co. Bessie B. Bodle.

33. *Dryopteris noveboracensis* (L.) Gr. New York Shield-fern. Damascus Twp., Henry Co. R. E. Shanks.

37. *Dryopteris goldiana* (Hook.) Gr. Goldie's Shield-fern. Wayne Twp., Tuscarawas Co. Don M. Brown. Zaleski, Vinton Co. Walter P. Porter. Brush Creek Twp., Highland Co. Katie M. Roads.

38. *Dryopteris marginalis* (L.) Gr. Marginal Shield-fern. Athens Co. Bessie B. Bodle.

40. *Dryopteris spinulosa* (Muell.) Ktz. Spinulose Shield-fern. Henry Twp., Wood Co. R. E. Shanks. Brush Creek Twp., Highland Co. Katie M. Roads.

42. *Polystichum acrostichoides* (Mx.) Schott. Christmas-fern. Brush Creek Twp. Highland Co. Katie M. Roads.

43. *Dennstaedtia punctilobula* (Mx.) Moore. Boulder-fern. Brown Twp., Carroll Co., and Jackson Twp., Stark Co. Don M. Brown.

45. *Cystopteris fragilis* (L.) Bernh. Fragil Bladder-fern. Henry Twp., Wood Co. R. E. Shanks.

46. *Woodsia obtusa* (Spreng.) Torr. Blunt-lobed Woodsia. Wayne Twp., Tuscarawas Co. Don M. Brown.
54. *Equisetum praealtum* Raf. Great Scouring-rush. Washington Twp., Henry Co. R. E. Shanks. Lawrence Twp., Tuscarawas Co. Don M. Brown.
61. *Equisetum arvense* L. Field Horsetail. Napoleon Twp., Henry Co. R. E. Shanks.

62. *Lycopodium selago*, var. *patens* (Beauv.) Desv. (*L. porophilum*, in part). Fir Club-moss. Portage, Tuscarawas, Licking, Hocking, Fairfield, Ross, Jackson, and Vinton Counties.
63. *Lycopodium lucidulum* Michx. Shining Club-moss. Lucas, Fulton, Allen, Wayne, Champaign, Ashtabula, Lake, Cuyahoga, Medina, Summit, Stark, Tuscarawas, Licking, Coshocton, Perry, Fairfield, Hocking, Ross, Meigs, and Jackson Counties.
63.1. *Lycopodium lucidulum*, var. *occidentale* (Clute.) Wilson. (*L. porophilum*, in part). Ashtabula, Portage, Fairfield, Hocking, Pike, and Jackson Counties.
64. *Lycopodium inundatum* L. Bog Club-moss. Lucas, Knox, Portage, Trumbull and Hocking Counties.
65. *Lycopodium clavatum* L. Common Club-moss. Ashtabula, Cuyahoga, Portage, Trumbull, Tuscarawas, Knox, Coshocton, Licking, Perry, and Hocking Counties.
65.1. *Lycopodium clavatum*, var. *megastachyon* Fernald & Bissell. Athens Co.
66. *Lycopodium obscurum* L. Tree Club-moss. Defiance, Lucas, Lake, Ashtabula, Trumbull, Medina, Portage, Holmes, Licking, Fairfield, Hocking and Jackson Counties.
66.1. *Lycopodium obscurum*, var. *dendroideum* Michx. Jackson Co.
67. *Lycopodium complanatum* L. Trailing Club-moss. Licking, Fairfield, Hocking and Jackson Counties.
67.1. *Lycopodium complanatum*, var. *flabelliforme* Fernald. Lucas, Lake, Cuyahoga, Geauga, Summit, Portage, Trumbull, Ashland, Stark, Columbiana, Knox, Coshocton, Tuscarawas, Carroll, Jefferson, Franklin, Muskingum, Belmont, Perry, Morgan, Noble, Washington, Ross, Vinton, Athens, Pike, Jackson, Meigs, Gallia and Lawrence Counties.
67.2 *Lycopodium tristachyum* Pursh. Ashtabula, Hocking and Jackson Counties. Lycopodium determinations by L. R. Wilson.

85. *Sagittaria rigida* Pursh. Sessile-fruited Arrow-head. Canton Twp., Stark Co. Don M. Brown.
94. *Potamogeton americanus* Cham. & Schl. Long-leaf Pondweed. Bethlehem Twp., Stark Co. Don M. Brown.
100. *Potamogeton praelongus* Wulf. White-stem Pondweed. Plain Twp., Stark Co. Don M. Brown.
101. *Potamogeton perfoliatus* L. Clasping-leaf Pondweed. Bethlehem Twp., Stark Co. Don M. Brown.
107.1. *Potamogeton diversifolius* Raf. Rafinesque's Pondweed. Hocking, Athens Co. Walter P. Porter.
110. *Potamogeton pectinatus* L. Fennel-leaf Pondweed. Plain Twp., Stark Co. Don M. Brown.
111. *Zannichellia palustris* L. Zannichellia. Jackson Twp., Stark Co. Don M. Brown.
115. *Nelumbo lutea* (Willd.) Pers. American Water-lotus. Lake Twp., Stark Co. Don M. Brown.
121. *Sparganium eurycarpum* Engelm. Broad-fruited Bur-reed. Hope, Vinton Co., and Buchtel, Athens Co. Walter P. Porter and P. S. Wamsley.
126. *Typha angustifolia* L. Narrow-leaf Cat-tail. Barberton, Summit Co. Don M. Brown.
131. *Arisaema dracontium* (L.) Schott. Green-dragon. Liberty Twp., Wood Co. R. E. Shanks.
140. *Scirpus lineatus* Mx. Reddish Bulrush. Montgomery Twp., Wood Co. R. E. Shanks.

146. *Scirpus validus* Vahl. Great Bulrush. Liberty Twp., Wood Co. R. E. Shanks.

156. Change *Eleocharis mutata* (L.) R. & S. to *E. quadrangulata* (Mx.) R. & S.
157. Change *Eleocharis acuminata* (Muhl.) Nees. to *E. compressa* Sull.
159. Change *Eleocharis tenuis* (Willd.) Schultes to *E. capitata* (L.) R. Br.
160. Change *Eleocharis intermedia* (Muhl.) Schultes to *E. reclinata* Kunth.
163. *Eleocharis engelmanni* Steud. No specimens.
164. *Eleocharis ovata* (Roth) R. & S. No specimens.
Eleocharis determinations by Ruth Lois Krehl.

166. *Stenophyllus capillaris* (L.) Britt. Hair-like Stenophyllus. Neotoma, Hocking Co. Edward S. Thomas.
168. *Cyperus strigosus* L. Straw-colored Cyperus. Hocking Twp., Fairfield Co. Robert Goslin. Chestnut Ridge, Sandusky Co., and Liberty Twp., Henry Co. R. E. Shanks.
170. *Cyperus filiculmis* Vahl. Slender Cyperus. Greenfield Twp., Fairfield Co. Robert Goslin.
173. *Cyperus engelmanni* Steud. Engelmann's Cyperus. Henry Twp., Wood Co. R. E. Shanks.
175. *Cyperus erythrorhizos* Muhl. Red-rooted Cyperus. Liberty Twp., Henry Co. R. E. Shanks.
189. *Scleria triglomerata* Mx. Tall Nut-rush. Oak Openings, Lucas Co. Floyd Bartley and Leslie L. Pontius.
196. *Carex convoluta* Mack. Convolute Sedge. Greenfield Twp., Fairfield Co. Robert Goslin.
202. *Carex lavenworthii* Dew. Leavenworth's Sedge. Bern Twp., Fairfield Co. Robert Goslin.
206. *Carex sparganioides* Muhl. Bur-reed Sedge. Richfield Twp., Henry Co., and Henry Twp., Wood Co. R. E. Shanks.
208. *Carex vulpinoidea* Mx. Fox Sedge. Berne Twp., Fairfield Co. Robert Goslin.
209. *Carex annectens* Bickn. Yellow Fox Sedge. Pleasant Twp., Fairfield Co. Robert Goslin.
215. *Carex laevi-vaginata* (Keuk.) Mack. Lancaster, Fairfield Co. William Goslin.
217. *Carex trisperma* Dew. Three-fruited Sedge. Greenfield Twp., Fairfield Co. Robert Goslin.
221. *Carex bromoides* Schk. Brome-like Sedge. Berne Twp., Fairfield Co. Robert Goslin.
233. *Carex straminea* Willd. Straw Sedge. Berne Twp., Fairfield Co. Robert Goslin.
247. *Carex emoryi* Dew. Emory's Sedge. Berne Twp., Fairfield Co. Charles and Robert Goslin.
253. *Carex durifolia* Bail. Back's Sedge. Silica Hollow, Hocking Co., and Waterloo Twp., Athens Co. Floyd Bartley and Leslie L. Pontius.
256. *Carex pennsylvanica* Lam. Pennsylvania Sedge. Berne Twp., Fairfield Co. William Goslin.
257. *Carex varia* Muhl. Emmon's Sedge. Waterloo Twp., Athens Co. Walter P. Porter. Pleasant Twp., Fairfield Co. Robert Goslin.
258. *Carex hirtifolia* Mack. Pubescent Sedge. Lancaster, Fairfield Co. Robert Goslin.
270. *Carex albursina* Sheld. White Bear Sedge. Greenfield Twp., Fairfield Co. Robert Goslin.
276. *Carex granularis* Muhl. Meadow Sedge. Lancaster, Fairfield Co. William Goslin.
289. *Carex swanii* (Fern.) Mack. Swan's Sedge. Greenfield Twp., Fairfield Co. Robert Goslin.
297. *Carex shortiana* Dew. Short's Sedge. Berne Twp., Fairfield Co. Robert Goslin.
317. *Carex frankii* Kunth. Frank's Sedge. Henry Twp., Wood Co. R. E. Shanks.

318. *Carex squarrosa* L. Squarrose Sedge. Washington Twp., Henry Co., and Henry Twp., Wood Co. R. E. Shanks.
321. *Carex asa-grayi* Bail. Gray's Sedge. Freedom Twp., Wood Co. R. E. Shanks.
323. *Carex lupulina* Muhl. Hop Sedge. Harrison Twp., Henry Co., and Montgomery Twp., Wood Co. R. E. Shanks.
329. *Bromus racemosus* L. Upright Chess. Berne Twp., Fairfield Co. Robert Goslin.
334. *Bromus purgans* L. Hairy Brome-grass. Lawrence Twp., Tuscarawas Co. Don M. Brown.
335. *Bromus tectorum* L. Downy Brome-grass. Hocking Twp., Fairfield Co. Robert Goslin.
342. *Festuca ovina* L. Sheep Fescue-grass. Hocking Twp., Fairfield Co. Robert Goslin.
344. *Festuca octoflora* Walt. Slender Fescue-grass. Jackson Twp., Stark Co. Don M. Brown.
350. *Panicularia nervata* (Willd.) Ktz. Nerved Mann-grass. Pike Twp., Stark Co. Don M. Brown.
361. *Poa triflora* Gilib. Fowl Meadow-grass. Plain Twp., Stark Co. Don M. Brown.
362. *Poa pratensis* L. Kentucky Blue-grass. Berne Twp., Fairfield Co. Robert Goslin.
365. *Dactylis glomerata* L. Orchard-grass. Berne Twp., Fairfield Co. Robert Goslin.
368. *Eragrostis major* Host. Strong-scented Love-grass. Liberty Twp., Wood Co. R. E. Shanks. Canton, Stark Co. Don M. Brown.
370. *Eragrostis purshii* Schrad. Pursh's Love-grass. Canton, Stark Co. Don M. Brown.
371. *Eragrostis pilosa* (L.) Beauv. Tufted Love-grass. Lancaster, Fairfield Co. Robert and William Goslin.
373. *Eragrostis capillaris* (L.) Ness. Capillary Love-grass. Lancaster, Fairfield Co. Robert Goslin. Athens Co. Len Stephenson.
385. *Arrhenatherum elatius* (L.) Beauv. Oat-grass. Hocking Twp., Fairfield Co. Robert Goslin.
386. *Trisetum pennsylvanicum* (L.) Beauv. Marsh False-oats. Greenfield Twp., Fairfield Co. Robert Goslin.
395. *Sporobolus vaginaeflorus* Torr. Sheathed Rush-grass. Lancaster, Fairfield Co. Robert Goslin.
404. *Agrostis alba* L. Red-top Bent-grass. Greenfield Twp., Fairfield Co. Robert Goslin. Hillsboro, Highland Co. Katie M. Roads.
407. *Agrostis hyemalis* (Walt.) B. S. P. Rough Bent-grass. Canton, Stark Co. Don M. Brown.
409. *Cinna arundinacea* L. Wood Reed-grass. Montgomery Twp., Wood Co. R. E. Shanks.
417. *Muhlenbergia mexicana* (L.) Trin. Mexican Muhlenbergia. Lancaster, Fairfield Co. Robert Goslin.
418. *Muhlenbergia racemosa* (Mx.) B. S. P. Marsh Muhlenbergia. Jackson Twp., Stark Co. Don M. Brown.
421. *Muhlenbergia schreberi* Gmel. Spreading Muhlenbergia. Liberty Twp., Wood Co. R. E. Shanks. Lancaster, Fairfield Co. Robert Goslin.
422. *Brachyelytrum erectum* (Schreb.) Beauv. Brachyelytrum. Wayne Twp., Tuscarawas Co. Don M. Brown.
423. *Millium effusum* L. Tall Millet-grass. Lawrence Twp., Tuscarawas Co. Don M. Brown.
427. *Aristida dichotoma* Mx. Poverty-grass. Neotoma, Hocking Co. Edward S. Thomas.
433. *Phalaris arundinacea* L. Reed Canary-grass. Liberty Twp., Wood Co. R. E. Shanks.
435. *Anthoxanthum odoratum* L. Sweet Vernal-grass. Lawrence Twp., Tuscarawas Co. Don M. Brown.
438. *Lolium multiflorum* Lam. Awned Darnel. Canton, Stark Co. Don M. Brown.

439. *Agropyron repens* (L.) Beauv. Couch-grass. Plain Twp., Stark Co. Don M. Brown. Lancaster, Fairfield Co. Robert Goslin.
440. *Agropyron smithii* Rydb. Western Wheat-grass. Introduced along railway tracks near Canton, Stark Co. Don M. Brown.
452. *Hordeum jubatum* L. Squirrel-tail Barley. Sugar Creek Twp., Stark Co. Don M. Brown. Lancaster, Fairfield Co. Robert Goslin.
460. *Homalocenchrus virginicus* (Willd.) Britt. Virginia Cut-grass Berne Twp., Fairfield Co. Robert Goslin. Richfield Twp., Henry Co. R. E. Shanks.
461. *Homalocenchrus oryzoides* (L.) Poll. Rice Cut-grass. Canton Twp., Stark Co. Don M. Brown.
463. *Zizania aquatica* L. Wild-rice. Summit Co. Don M.. Brown.
466. *Panicum virgatum* L. Tall Smooth Panic-grass. Canton Twp., Stark Co. Don M. Brown.
467. *Panicum dichotomiflorum* Mx. Spreading Panic-grass. Richfield Twp., Henry Co. R. E. Shanks. Berne Twp., Fairfield Co. Robert Goslin.
473. *Panicum gattingeri* Nash. Gattinger's Panic-grass. Lancaster, Fairfield Co. Robert Goslin.
479. *Panicum linearifolium* Scribn. Linear-leaf Panic-grass. Pleasant Twp., Fairfield Co. Robert Goslin.
488. *Panicum lindheimeri* Nash. Lindheimer's Panic-grass. Adams Co. Floyd Bartley and Leslie L. Pontius.
496. *Panicum clandestinum* L. Hispid Panic-grass. Harrison Twp., Henry Co. R. E. Shanks.
497. *Panicum latifolium* L. Broad-leaf Panic-grass. Liberty Twp., Wood Co. R. E. Shanks.
498. *Panicum boscii* Poir. Bosc's Panic-grass. Liberty Twp., Wood Co. R. E. Shanks.
499. *Leptoloma cognatum* (Schultes) Chase. Fall Witch-grass. Penn Twp., Highland Co. Katie M. Roads.
500. *Syntherisma filiforme* (L.) Nash. Slender Crab-grass. Neotoma, Hocking Co. Edward S. Thomas.
501. *Syntherisma ischaemum* (Schreb.) Nash. Small Crab-grass. Pike Twp., Stark Co. Don M. Brown.
508. *Paspalum setaceum* Mx. Slender Paspalum. Berne Twp., Fairfield Co. Robert Goslin.
509. *Chaetochloa verticillata* (L.) Scribn. Verticillate Foxtail-grass. Lancaster, Fairfield Co. Robert Goslin.
513. *Cenchrus pauciflorus* Benth. Sandbur-grass. Lancaster, Fairfield Co. Robert and William Goslin.
516. *Sorghastrum nutans* (L.) Nash. Indian-grass. Berne Twp., Robert, William and Charles Goslin.
519. *Andropogon furcatus* Muhl. Big Bluestem. New Vienna, Clinton Co. Katie M. Roads. Sandy Twp., Stark Co. Don M. Brown.
522. *Andropogon scoparius* Mx. Little Bluestem. Jackson Twp., Stark Co. Don M. Brown.
527. *Lilium canadense* L. Canada Lily. Berne Twp., Fairfield Co. Robert and William Goslin. Pike Twp., Stark Co. Don M. Brown. Burton, Geauga Co. C. A. Dambach.
531. *Erythronium albidum* Nutt. White Dog-tooth Lily. Lawrence Twp., Tuscarawas Co. Don M. Brown.
534. *Allium tricoccum* Ait. Wild Leek. Sugarcreek Twp., Stark Co. Don M. Brown. Brush Creek Twp., Highland Co. Katie M. Roads.
535.1. *Allium sativum* L. European Garlic. New Vienna, Clinton Co. Katie M. Roads.
541. *Quamasia hyacinthina* (Raf.) Britt. Wild Hyacinth. Sugarcreek Twp., Stark Co. Don M. Brown.
551. *Anticlea elegans* (Pursh.) Rydb. Glaucous Anticlea. New Moorefield, Clark Co. C. A. Dambach.
552. *Stenanthium robustum* Wats. Stout Stenanthium. Pike Twp., Stark Co. Don M. Brown.
554. *Triantha glutinosa* (Mx.) Baker. Glutinous Triantha. New Moorefield, Clark Co. C. A. Dambach.

562. *Medeola virginiana* L. Indian Cucumber-root. Liberty Twp., Wood Co. R. E. Shanks. Burton, Geauga Co. C. A. Dambach.
567. *Disporum lanuginosum* (Mx.) Nich. Hairy Disporum. Greenfield Twp., Fairfield Co. Robert Goslin. Osnaburg Twp., Stark Co. Don M. Brown.
571. *Vagnera racemosa* (L.) Mor. Panicled False Solomon's-seal. Burton, Geauga Co. C. A. Dambach.
572. *Vagnera stellata* (L.) Mor. Stellate False Solomon's-seal. Jackson Twp., Stark Co. Don M. Brown.
584. *Smilax rotundifolia* L. Round-leaf Greenbriar. Wayne Twp., Tuscarawas Co. Don M. Brown.
593. *Juncus effusus* L. Common Rush. Montgomery Twp., Wood Co. R. E. Shanks.
596. *Juncus dudleyi* Wieg. Dudley's Rush. Berne Twp., Fairfield Co. Robert Goslin.
597. *Juncus tenuis* Willd. Slender Rush. Neotoma, Hocking Co. Edward S. Thomas.
617. *Hypoxis hirsuta* (L.) Cov. Yellow Stargrass. Brown Twp., Carroll Co. Don M. Brown.
627. *Iris versicolor* L. Northern Blue-flag. Hooker, Fairfield Co. William Goslin. Also Waynesburg, Carroll Co., and Barberton, Summit Co. Don M. Brown.
644. *Lysias orbiculata* (Pursh.) Rydb. Large Round-leaf Orchis. Brown Twp., Carroll Co. Don M. Brown.
648. *Blephariglottis lacera* (Mx.) Farw. Ragged Fringed-orchis. Burton, Geauga Co. C. A. Dambach.
652. *Blephariglottis psycodes* (L.) Rydb. Smaller Purple Fringed-orchis. Oak Openings, Lucas Co. Floyd Bartley and Leslie L. Pontius.
658. *Ibidium gracile* (Bigel.) House. Slender Lady's-tresses. Mill Twp., Tuscarawas Co. Irma Nelson.
666. *Malaxis unifolia* Mx. Green Adder-mouth. Vinton Co. Floyd Bartley and Leslie L. Pontius.
667. *Liparis liliifolia* (L.) Rich. Large Twayblade. Mill Twp., Tuscarawas Co. Irma Nelson. Brown Twp., Carroll Co. Don M. Brown.
672. *Corallorrhiza maculata* Raf. Large Coral-root. Rock Run, Jackson Co. Floyd Bartley and Leslie L. Pontius.
679. *Liriodendron tulipifera* L. Tuliptree. Damascus Twp., Henry Co. R. E. Shanks.
680. *Asimina triloba* (L.) Dunal. Papaw. Damascus Twp., Henry Co. R. E. Shanks.
682.1. *Ranunculus alleghaniensis* Britt. Mountain Crow-foot. Hope, Vinton Co. Walter P. Porter.
691. *Ranunculus fascicularis* Muhl. Tufted Buttercup. Twerton Twp., Coshocton Co. Floyd Von Ohlen.
706. *Delphinium tricorne* Mx. Dwarf Larkspur. Fairfield Twp., Tuscarawas Co. Don M. Brown.
740. *Benzoin aestivale* (L.) Nees. Spicebush. Montgomery Twp., Wood Co. R. E. Shanks.
764.1. *Lesquerella globosa* (Desv.) S. Wats. Short's Bladder-pod. Vinton Co. Len Stephenson.
769. *Camelina sativa* (L.) Crantz. Common False-flax. Berne Twp., Fairfield Co. Robert Goslin.
770. *Camelina microcarpa* Andrz. Small-fruited False-flax. Jackson Twp., Stark Co. Don M. Brown.
779. *Lepidium campestre* (L.) R. Br. Field Peppergrass. Hocking Twp., Fairfield Co. William Goslin.
786. *Thlaspi arvense* L. Field Penny-cress. Berne Twp., Fairfield Co. Robert Goslin.
791. *Sophia incisa* (Engelm.) Greene. Western Tansy-mustard. Berne Twp., Fairfield Co. Robert and William Goslin.
821. *Cardamine pennsylvanica* Muhl. Pennsylvania Bitter-cress. Berne Twp., Fairfield Co. Robert Goslin.

827. *Dentaria heterophylla* Nutt. Slender Toothwort. Berne Twp., Fairfield Co. William Goslin.
828. *Dentaria multifida* Muhl. Multifid Toothwort. Lodi Twp., Athens Co. Walter P. Porter.
853. *Geranium pusillum* L. Small-flowered Crane's-bill. Lawrence Twp., Tuscarawas Co. Don M. Brown.
862. *Oxalis violacea* L. Violet Wood-sorrel. Brown Twp., Carroll Co. Don M. Brown.
872. *Floerkea proserpinacoides* Willd. False-mermaid. Pleasant Twp., Fairfield Co. Robert Goslin. Lodi Twp., Athens Co. Walter P. Porter.
876. *Zanthoxylum americanum* Mill. Prickly-ash. Sugar Creek Twp., Stark Co. Don M. Brown.
877. *Ptelea trifoliata* L. Hop-tree. Sandy Twp., Tusacrawas Co. Don M. Brown. Troy Twp., Wood Co. R. E. Shanks.
883. *Polygala incarnata* L. Pink Milkwort. Madison Twp., Fairfield Co. Helen and Jean Rea.
892. *Croton monanthogynus* Mx. Single-fruited Croton. Canaan Twp., Athens Co. Warren Abbott.
895. *Poinsettia dentata* (Mx.) Small. Toothed Spurge. Bellefontaine, Logan Co. A. G. Welshimer.
898. *Tithymalus platyphyllus* (L.) Hill. Broadleaf Spurge. Maumee, Lucas Co. Chas. C. Deam.
903. *Tithymalus peplus* (L.) Hill. Petty Spurge. Hillsboro, Highland Co. Katie M. Roads.
905. *Tithymalopsis corollata* (L.) Kl. and Garcke. Flowering Spurge. Washington Twp., Henry Co. R. E. Shanks.
915. *Callitriche austini* Engelm. Terrestrial Water-starwort. Scioto Twp., Ross Co. Edward S. Thomas, Joe Enke and J. S. Thomas.
925. *Napaea dioica* L. Glade Mallow. Dover Twp., Tuscarawas Co. Clyde H. Jones.
931. *Hibiscus trionum* L. Bladder Ketmia. Athens, Athens Co. Flora E. Hall.
937. *Hypericum prolificum* L. Shrubby St. John's-wort. Burton, Geauga Co. C. A. Dambach.
939. *Hypericum perforatum* L. Common St. John's-wort. Zane Twp., Logan Co. A. G. Welsheimer. Henry Twp., Wood Co. R. E. Shanks.
944. *Hypericum mutilum* L. Small-flowered St. John's-wort. Washington Twp., Highland Co. Katie M. Roads. Damascus Twp., Henry Co. R. E. Shanks.
950. *Triadenum virginicum* (L.) Raf. Marsh St. John's-wort. Sandy Twp., Stark Co. Don M. Brown.
952. *Crocanthemum majus* (L.) Britt. Hoary Frostweed. Plain Twp., Wood Co. R. E. Shanks.
956. *Lechea racemulosa* Lam. Oblong-fruited Pinweed. Mill Twp., Tuscarawas Co. Irma Nelson.
962. *Cubelium concolor* (Forst.) Raf. Green Violet. Dover Twp., Tuscarawas Co. Irma Nelson.
964. *Viola eriocarpa* Schw. Smooth Yellow Violet. Athens Twp., Athens Co. Warren Abbott.
967. *Viola striata* Ait. Striped Violet. Brown Twp., Carroll Co. Don M. Brown. Dover Twp., Tuscarawas Co. Irma Nelson.
970. *Viola rostrata* Pursh. Long-spurred Violet. Plain Twp., Stark Co. Don M. Brown. Dover Twp., Tuscarawas Co. Irma Nelson.
971. *Viola rafinesquii* Greene. Wild Pansy. Alexander Twp., Athens Co. Harold H. Moore.
971.1. *Viola arvensis* Murr. Field Pansy. Lawrence Twp., Tuscarawas Co. Don M. Brown.
975. *Viola blanda* Willd. Sweet White Violet. Athens Twp., Athens Co. Warren Abbott.
976. *Viola pallens* (Banks) Brain. Woodland White Violet. Plain Twp., Stark Co. Don M. Brown.
980. *Viola papilionacea* Pursh. Common Blue Violet. Canton, Stark Co. Don M. Brown.

981. *Viola sororia* Willd. Woolly Blue Violet. Loudonville, Ashland Co. Don M. Brown.
994. *Viola palmata* L. Early Blue Violet. Athens Twp., Athens Co. Warren Abbott.
987. *Viola fimbriatula* Sm. Ovate-leaf Violet. Sandy Twp., Stark Co. Rose Twp., Carroll Co. Don M. Brown. Red Hills, Franklin Co. C. A. Dambach.
988. *Viola sagittata* Ait. Arrow-leaf Violet. Plain Twp., Stark Co. Don M. Brown. The Plains, Athens Co. Walter P. Porter.
990. *Passiflora incarnata* L. Purple Passion-flower. Escaped from cultivation on North Hill, Athens, Athens Co. Warren Abbott.
1001. *Alsine media* L. Common Chickweed. Lawrence Twp., Tuscarawas Co. Don M. Brown.
1003. *Alsine longifolia* (Muhl.) Britt. Longleaf Stitchwort. Berne Twp., Fairfield Co. Robert Goslin.
1104. *Alsine graminea* (L.) Britt. Lesser Stitchwort. Hospital Grounds, Athens, Athens Co. Walter P. Porter and P. S. Wamsley.
1005. *Cerastium vulgatum* L. Common Mouse-ear Chickweed. Pleasant Twp., Fairfield Co. Robert Goslin. Athens, Athens Co. Warren Abbott.
1006. *Cerastium viscosum* L. Mouse-ear Chickweed. Conkle's Hollow, Hocking Co. Edward S. Thomas and A. R. Harper. Athens Twp., Athens Co. Warren Abbott.
1013. *Agrostemma githago* L. Corn Cockle. Burton, Geauga Co. C. A. Dambach.
1015. *Lychnis alba* Mill. White Lychnis. Willowdale Lake, Stark Co. Don M. Brown.
1020. *Silene latifolia* (Mill.) Britt. & Rend. Bladder Campion. Brown Twp., Carroll Co. Don. M. Brown. Mantua Twp., Portage Co. C. A. Dambach.
1026. *Silene virginica* L. Fire Pink. Athens Twp., Athens Co. Warren Abbott. Liberty Twp., Wood Co. R. E. Shanks.
1031. *Silene antirrhina* L. Sleepy Catchfly. Liberty Twp., Wood Co. R. E. Shanks.
1038. *Claytonia virginica* L. Spring-beauty. Lawrence Twp., Tuscarawas Co. Don M. Brown.
1042. *Mollugo verticillata* L. Carpetweed. Liberty Twp., Wood Co. R. E. Shanks.
1047. *Anychia polygonoides* Raf. Forked Anychia. Pike Twp., Stark Co. Don M. Brown.
1048. *Anychia canadensis* (L.) B. S. P. Slender Anychia. Liberty Twp., Wood Co. R. E. Shanks.
1052. *Amaranthus hybridus* L. Slender Pigweed. Liberty Twp., Wood Co. R. E. Shanks.
1054. *Amaranthus graecizans* L. Tumble-weed. Willowdale Lake, Stark Co. Don M. Brown.
1056. *Acnida tuberculata* Moq. Tubercled Water-hemp. Berne Twp., Fairfield Co. Robert and William Goslin.
1068. *Chenopodium botrys* L. Feather-geranium. Barberton, Summit Co. Don M. Brown.
1081. *Steironema lanceolatum* (Walt.) Gr. Lanceleaf Yellow Loosestrife. Hocking Twp., Fairfield Co. William Goslin.
1085. *Lysimachia nummularia* L. Moneywort. Berne Twp., Fairfield Co. William Goslin. Burton, Geauga Co. C. A. Dambach.
1094. *Rumex verticillatus* L. Swamp Dock. Burton, Geauga Co. C. A. Dambach.
1095. *Rumex altissimus* Wood. Tall Dock. Berne Twp., Fairfield Co. Robert and William Goslin.
1098. *Rumex britannica* L. Great Water Dock. Willowdale Lake, Stark Co. Don M. Brown.
1106. *Tiniaria dumetorum* (L.) Opiz. Copse False Buckwheat. Canaan Twp., Athens Co. Warren Abbott.
1109. *Tracaulon arifolium* (L.) Raf. Halberd-leaf Tear-thumb. Berne Twp., Fairfield Co. Robert Goslin.
1113. *Persicaria hydropiperoides* (Mx.) Small. Mild Smartweed. Henry Twp., Wood Co. R. E. Shanks.

1118. *Persicaria muhlenbergii* (Wats.) Small. Swamp Persicaria. Berne Twp., Fairfield Co. Robert and William Goslin.
1128. *Geum vernum* (Raf.) T. & G. Spring Avens. Liberty Twp., Wood Co. R. E. Shanks.
1129. *Geum canadense* Jacq. White Avens. Berne Twp., Fairfield Co. William Goslin. Liberty Twp., Wood Co. R. E. Shanks.
1131. *Geum flavum* (Port.) Bickn. Cream-colored Avens. Athens Co. Floyd Bartley and Leslie L. Pontius.
1138. *Potentilla canadensis* L. Common Five-finger. Burton, Geauga Co. C. A. Dambach.
1143. *Drymocallis agrimonioides* (Pursh.) Rydb. Tall Cinquefoil. Isaac Walton Farm, Athens Co. Walter P. Porter.
1144.1. *Duchesnea indica* (Andr.) Fooke. Indian Strawberry. Athens Co. Warren Abbott.
1149. *Rubus phoenicolasius* Max. Wineberry. Salem Twp., Meigs Co. Clyde H. Jones.
1151. *Ribus strigosus* Mx. Wild Red Raspberry. Salem Twp., Meigs Co. Clyde H. Jones.
1153. *Rubus laciniatus* Willd. Cutleaf Blackberry. Champaign Co. Margaret B. Church.
1159. *Porteranthus trifoliatus* (L.) Britt. Indian-physic. O. S. U. Botanical Garden. Introduced with Rhododendron clumps from the Great Smokies. Clyde H. Jones.
1162. *Filipendula rubra* (Hill.) Rob. Queen-of-the-prairie. The Plains, Athens Co. Walter P. Porter.
1164. *Opulaster opulifolius* (L.) Ktz. Ninebark. Monroe Twp., Henry Co. R. E. Shanks. Berne Twp., Fairfield Co. Robert Goslin.
1168. *Aruncus sylvester* Kost. Aruncus. Fairfield Co. William Goslin.
1171. *Rosa rubiginosa* L. Sweetbriar. Liberty Twp., Wood Co. R. E. Shanks.
1178. *Rosa virginiana* Mill. Virginia Rose. Liberty Twp., Wood Co. R. E. Shanks.
1180. *Agrimonia rostellata* Wallr. Woodland Agrimony. Lawrence Twp., Tuscarawas Co. Don M. Brown.
1183. *Agrimonia gryposepala* Wallr. Hairy Agrimony. Berne Twp., Fairfield Co. William Goslin.
1207. *Amelanchier sanguinea* (Pursh.) DC. Roundleaf Juneberry. Good Hope Twp., Hocking Co. Edward S. Thomas.
1234. *Cassia marilandica* L. Wild Senna. Hocking Co. Warren Abbott.
1240. Change to 1240a. *Baptisia tinctoria crebra* Fernald. *B. tinctoria typica* is not known to occur in the state. Baptisia determinations by M. M. Larisey.
1248. *Trifolium agrarium* L. Yellow Hop Clover. Plain Twp., Stark Co. Don M. Brown.
1261. *Cracca virginiana* L. Virginia Goat's-rue. Mill Twp., Tuscarawas Co. Irma Nelson.
1269. *Psoralea onobrychis* Nutt. Sainfoin Psoralea. Fairfield Co. William Goslin.
1273. *Meibomia canescens* (L.) Ktz. Hoary Tick-trefoil. Berne Twp., Fairfield Co. William Goslin.
1276. *Meibomia michauxii* Vail. Prostrate Tick-trefoil. Newark Twp., Licking Co. Warren Abbott.
1284. *Meibomia sessilifolium* (Torr.) Ktz. Sessile-leaf Tick-trefoil. Oak Openings, Lucas Co. Floyd Bartley and Leslie L. Pontius.
1288. *Meibomia nudiflora* (L.) Ktz. Naked-flowered Tick-trefoil. Perry Twp., Tuscarawas Co. Irma Nelson.
1290. *Lespedeza capitata* Mx. Round-headed Bush-clover. Jackson Twp., Stark Co. Don M. Brown.
1296. *Lespedeza procumbens* Mx. Trailing Bush-clover. Athens Twp., Athens Co. Walter P. Porter. Wingfoot Lake, Portage Co. Don M. Brown.
1300. *Vicia cracca* L. Cow Vetch. Suffield, Portage Co. Don M. Brown.
1318. *Glycine apios* L. Groundnut. Berne Twp., Fairfield Co. Robert Goslin.
1331. *Penthorum sedoides* L. Ditch Stonecrop. Pleasant Twp., Henry Co. R. E. Shanks.
1332. *Micranthes virginiensis* (Mx.) Small. Early Saxifrage. Wayne Twp., Tuscarawas Co. Don M. Brown. Athens, Athens Co. Warren Abbott.

1333. *Micranthes pennsylvanica* (L.) Haw. Pennsylvania Saxifrage. The Plains, Athens Co. Walter P. Porter and P. S. Wamsley.
1335. *Tiarella cordifolia* L. False Miterwort. Athens, Athens Co. Warren Abbott.
1336. *Heuchera americana* L. Common Alum-root. Liberty Twp., Wood Co. R. E. Shanks.
1346. *Lythrum alatum* Pursh. Wing-angled Loosestrife. Licking Co. Warren Abbott. Berne Twp., Fairfield Co. Robert and William Goslin. Liberty Twp., Wood Co. R. E. Shanks.
1353. *Rhamnus frangula* L. Black Buckthorn. Canton Twp., Stark Co. Don M. Brown.

1359. *Vitis labrusca* L. Northern Fox Grape. Lorain and Jackson Counties.
1359.1. *Vitis labruscana* Bail. Ashtabula County.
1360. *Vitis aestivalis* Mx. Summer Grape. Auglaize, Medina, Summit, Monroe, Jackson and Lawrence Counties.
1360.1. *Vitis aestivalis*, form *argenifolia* (Muns.) Fernald. General in the plateau counties of the state.
1361. *Vitis cinera* Engelm. Ashy Grape. Brown, Scioto, and Meigs Counties.
1362. *Vitis bicolor* LeC. Winter Grape. General in the plateau counties of the state. Also Williams and Henry Counties.
1363. *Vitis vulpina* L. Riverside Grape. General.
1364. *Vitis cordifolia* Mx. Frost Grape. General.
Vitis determinations by R. W. Pohl.

1370. *Euonymus obovatus* Nutt. Running Strawberry-bush. Brown Twp., Carroll Co. Don M. Brown.
1375. *Ilex verticillata* (L.) Rr. Winterberry. Wayne Twp., Tuscarawas Co. Don M. Brown. The Plains, Athens Co. Walter P. Porter. Liberty Twp., Wood Co. R. E. Shanks. Berne Twp., Fairfield Co. Robert Goslin.
1376. *Staphylea trifolia* L. American Bladdernut. Berne Twp., Fairfield Co. William Goslin. Henry Twp., Wood Co. R. E. Shanks.
1381. *Acer nigrum* Mx. Black Maple. Troy Twp., Wood Co. R. E. Shanks.
1382. *Acer saccharum* Marsh. Sugar Maple. Fairfield Twp., Tuscarawas Co. Don M. Brown.
1389. *Rhus hirta* (L.) Sudw. Staghorn Sumac. Portage and Stark Counties. Don M. Brown.
1391. *Schmaltzia crenata* (Mill.) Greene. Fragrant Sumac. Troy Twp., Wood Co. R. E. Shanks.
1407. *Cannabis sativa* L. Hemp. Mad River Twp., Champaign Co. A. G. Welshimer.
1411. *Urtica dioica* L. Stinging Nettle. Wingfoot Lake, Portage Co. Don M. Brown.
1414. *Pilea pumila* (L.) Gr. Clearweed. Brush Creek Twp., Highland Co. Katie M. Roads.
1415. *Boehmeria cylindrica* (L.) Sw. False Nettle. Plain Twp., Wood Co. R. E. Shanks.
1416. *Parietaria pennsylvania* Muhl. Pennsylvania Pellitory. Troy Twp., Wood Co. R. E. Shanks.
1421. *Quercus montana* Willd. Rock Chestnut Oak. Brush Creek Twp., Highland Co. Katie M. Roads.
1423. *Quercus alba* L. White Oak. Waynesburg, Stark Co. Don M. Brown.
1425. *Quercus macrocarpa* Mx. Bur Oak. Plain Twp., Stark Co. Don M. Brown.
1426.1. *Quercus leana* Nutt. (*imbricaria* x *velutina*). Lea's Oak. Kettle Hills, Fairfield Co. Clyde H. Jones.
1431 *Quercus coccinea* Wang. Scarlet Oak. Canton Twp., Stark Co. Don M. Brown.
1432. *Quercus rubra* L. Red Oak. Liberty Twp., Wood Co. R. E. Shanks.
1434. *Carpinus caroliniana* Walt. Blue-beech. Lawrence Twp., Tuscarawas Co. Don M. Brown.
1444. *Alnus vulgaris* Hill European Alder. Escaped from cultivation and growing at the mouth of Chagrin River, Lake Co. Don M. Brown.

1447. *Hicoria microcarpa* (Nutt.) Britt. Small-fruited Hickory. Montgomery Twp., Wood Co. R. E. Shanks.
1453. *Juglans cinera* L. Butternut. Troy Twp., Wood Co. R. E. Shanks.
1457. *Populus heterophylla* L. Swamp Poplar. Canton Twp., Stark Co. Don M. Brown.
1465. *Salix nigra* Marsh. Black Willow. Plain Twp., Stark Co. Don M. Brown.
1467. *Salix fragilis* L. Crack Willow. Richfield Twp., Henry Co. R. E. Shanks.
1471. *Salix babylonica* L. Weeping Willow. A dozen large trees in a swamp near Hillsboro, Highland Co. Katie M. Roads.
1472. *Salix interior* Row. Sandbar Willow. Montgomery Twp., Wood Co. R. E. Shanks.
1473a. *Salix glaucophylla albovestita* Ball. Erie Co.
1474. *Salix cordata* Muhl. Heartleaf Willow. Athens Twp., Athens Co. Harold H. Moore.
1475. *Salix adenophylla* Hook. is a northern species and is not known to occur in Ohio.
1476. *Salix pedicellaris* Pursh. Bog Willow. Jackson Twp., Stark Co. Don M. Brown.
1482. *Salix humulis* Marsh. Prairie Willow. Dover Twp., Tuscarawas Co. Don M. Brown. Washington Twp., Henry Co. R. E. Shanks.
1488. *Hydrangea arborescens* L. Wild Hydrangea. Wayne Twp., Tuscarawas Co. Don M. Brown.
1490. *Ribes americanum* Mill. Wild Black Currant. Berne Twp., Fairfield Co. Robert Goslin.
1499. *Ludwigia alternifolia* L. Seed-box. Jackson Twp., Stark Co. Don M. Brown.
1501. *Chamaenerion angustifolium* (L.) Scop. Fire-weed. Brown Twp., Carroll Co. Don M. Brown.
1503. *Epilobium strictum* Muhl. Downy Willow-herb. Jackson Twp., Stark Co. Don M. Brown.
1505. *Epilobium adenocaulon* Haussk. Northern Willow-herb. Berne Twp., Fairfield Co. William Goslin.
1509. *Kneiffia pratensis* Small. Meadow Sundrops. Wayne Twp., Tuscarawas Co. Don M. Brown.
1510. *Kneiffia pumila* (L.) Spach. Small Sundrops. Lawrence Twp., Tuscarawas Co. Don M. Brown.
1512. *Kneiffia fruticosa* (L.) Raim. Common Sundrops. Fairfield Co. William Goslin.
1516. *Gaura biennis* L. Biennial Gaura. Lawrence Twp., Tuscarawas Co. Don M. Brown.
1517. *Circaea lutetiana* L. Common Enchanter's-nightshade. Liberty Twp., Wood Co. R. E. Shanks.
1542. *Kalmia latifolia* L. Mountain Kalmia. Wayne Twp., Tuscarawas Co. Don M. Brown.
1543. *Epigaea repens* L. Trailing Arbutus. Sandy Twp., Stark Co. Don M. Brown.
1551. *Pyrola elliptica* Nutt. Shinleaf Wintergreen. Rush Twp., Tuscarawas Co. Irma Nelson. Berne Twp., Fairfield Co. William Goslin.
1558. *Polycodium stamineum* (L.) Greene. Deerberry. Fairfield Twp., Tuscarawas Co. Don M. Brown.
1567. *Gaylussacia baccata* (Wang.) Kock. Black Huckleberry. Washington Twp., Henry Co. R. E. Shanks.
1568. *Diospyros virginiana* L. Persimmon. Hocking Twp., Fairfield Co. William Goslin.
1571.1. *Polemonium reptans* L. var. *villosum* Braun. Hairy Greek Valerian. Segregated as a variety in 1939 by E. Lucy Braun from material collected in Adams Co. Examination of the Polemonium material in the State Herbarium yields specimens of this variety from the following counties: Scioto, Pike, Jackson, Lawrence, Montgomery, Mercer, and Darke.
1575. *Phlox paniculata* L. Garden Phlox. (Albino form). Zaleski, Vinton Co. Walter P. Porter.
1589. *Convolvus spithamaeus* L. Upright Bindweed. Mill Twp., Tuscarawas Co. Irma Nelson.

1606. *Phacelia purshii* Buckl. Pursh's Phacelia. Millville Twp., Butler Co. C. A. Dambach.
1615. *Fraxinus quadrangulata* Mx. Blue Ash. Marion Twp., Henry Co. Troy Twp., Wood Co. R. E. Shanks.
1628. *Gentiana andrewsii* Griseb. Closed Gentian. Harrison Twp., Henry Co. R. E. Shanks.
1632. *Bartonia virginica* (L.) B. S. P. Yellow Bartonia. Oak Openings. Lucas Co. Floyd Bartley and Leslie L. Pontius.
1636. *Apocynum androsaemifolium* L. Spreading Dogbane. Plain Twp., Wood Co. R. E. Shanks. Burton, Geauga Co. C. A. Dambach.
1637. *Apocynum medium* Greene. Intermediate Dogbane. Union Twp., Logan Co. A. G. Welshimer.
1638. *Apocynum cannabinum* L. Indian-hemp. Union Twp., Logan Co. A. G. Welshimer.
1641. *Asclepiodora viridis* (Walt.) Gr. Oblong-leaf Green Milkweed. Scioto Twp., Ross Co. Edward S. Thomas.
1642. *Acerates viridiflora* (Raf.) Eat. Green Milkweed. Union Twp., Logan Co. A. G. Welshimer.
1645. *Asclepias purpurascens* L. Purple Milkweed. Champaign Co. Margaret B. Church.
1646. *Asclepias incarnata* L. Swamp Milkweed. Plain Twp., Wood Co. R. E. Shanks.
1653. *Asclepias quadrifolia* Jacq. Fourleaf Milkweed. Mill Twp., Tuscarawas Co. Irma Nelson and R. C. Wallace. Plain Twp., Stark Co. Don M. Brown.
1655. *Gonolobus laevis* Mx. Sandvine. Crawford Co. Don M. Brown.
1657. *Vincetoxicum obliquum* (Jacq.) Britt. Large-flowered Vincetoxicum. Moonville, Vinton Co. Walter P. Porter.
1681. *Solanum dulcamara* L. Bitter-sweet. Burton, Geauga Co. C. A. Dambach.
1682. *Verbascum blattaria* L. Moth Mullen. Burton, Geauga Co. C. A. Dambach.
1686. *Penstemon digitalis* (Sweet) Nutt. Foxglove Beard-tongue. Canton, Stark Co. Don M. Brown.
1694. *Scrophularia marylandica* L. Maryland Figwort. Berne Twp., Fairfield Co. William Goslin.
1699. *Leucospora multifida* (Mx.) Penn. Leucospora. Hocking Twp., Fairfield Co. Robert Goslin.
1701. *Gratiola neglecta* Torr. Clammy Hedge-hyssop. Vinton Co. Len Stephenson. Athens Co. Walter P. Porter.
1701.1. *Gratiola viscidula shortii* Penn. Athens, Athens Co. Warren Abbott.
1707. *Aureolaria flava* (L.) Farw. Smooth False Foxglove. Rush Twp., Tuscarawas Co. C. W. Wallace.
1711. *Agalinis purpurea* (L.) Penn. Large-flowered Agalinis. Washington Twp., Henry Co. Liberty Twp., Wood Co. R. E. Shanks.
1720. *Veronica officinalis* L. Common Speedwell. Burton, Geauga Co. C. A. Dambach.
1726. *Veronica serpyllifolia* L. Thyme-leaf Speedwell. Pleasant Twp., Fairfield Co. William Goslin.
1728. *Veronica arvensis* L. Field Speedwell. Liberty Twp., Wood Co. R. E. Shanks.
1751. *Thalesia uniflora* (L.) Britt. Naked Broom-rape. Adams Co. John N. Wolfe.
1753. *Conopholis americana* (L. f.) Wallr. Squaw-root. Athens, Athens Co. Warren Abbott.
1754. *Leptamnium virginianum* (L.) Raf. Beech-drops. Richfield Twp., Henry Co. R. E. Shanks.
1759. *Stomoisia cornuta* (Mx.) Raf. Horned Bladderwort. Plain Twp., Stark Co. Don M. Brown.
1768. *Cynoglossum officinale* L. Hound's-tongue. Champaign Co. Margaret B. Church.
1769. *Cynoglossum virginianum* L. Wild Comfrey. Athens, Athens Co. Warren Abbott.
1773. *Lithospermum arvense* L. Corn Gromwell. Athens, Athens Co. Warren Abbott.
1786. *Echium vulgare* L. Blue-weed. Suffield Twp., Portage Co. Don M. Brown.

1787. *Verbena urticaefolia* L. White Vervain. Henry Twp., Wood Co. R. E. Shanks.
1789. *Verbena angustifolia* Mx. Narrowleaf Vervain. Bloom and Liberty Twps., Wood Co. R. E. Shanks.
1793. *Lippia lanceolata* Mx. Frog-fruit. Damascus Twp., Henry Co. R. E. Shanks.
1799. *Teucrium occidentale* Gr. Hairy Germander. Berne Twp., Fairfield Co. William Goslin.
1801. *Scutellaria lateriflora* L. Mad-dog Skullcap. Plain Twp., Wood Co. R. E. Shanks. Berne Twp., Fairfield Co. Robert and William Goslin.
1809. *Scutellaria galericulata* L. Marsh Skullcap. Oak Openings, Lucas Co. Floyd Bartley and Leslie L. Pontius.
1810. *Scutellaria nervosa* Pursh. Veined Skullcap. Wayne Twp., Tuscarawas Co. Don M. Brown.
1821. *Lycopus americanus* Muhl. Cutleaf Water-hoarhound. Berne Twp., Fairfield Co. Robert Goslin.
1823. *Lycopus virginicus* L. Virginia Water-hoarhound. Brown Twp., Carroll Co. Don M. Brown.
1826. *Collinsonia canadensis* L. Stone-root. Berne Twp., Fairfield Co. William Goslin. Damascus Twp., Henry Co. R. E. Shanks.
1827. *Koellia virginiana* (L.) MacM. Virginia Mountain-mint. Berne Twp., Fairfield Co. William Goslin. Washington Twp., Henry Co. R. E. Shanks.
1828. *Koellia flexuosa* (Walt.) MacM. Narrowleaf Mountain-mint. Berne Twp., Fairfield Co. William Goslin. Jackson Twp., Stark Co. Don M. Brown.
1830. *Koellia incana* (L.) Ktz. Hoary Mountain-mint. Dover Twp., Tuscarawas Co. Don M. Brown.
1839. *Melissa officinalis* L. Lemon Balm. Canton, Stark Co. Don M. Brown.
1840. *Hedeoma pulegioides* (L.) Pers. American Pennyroyal. Berne Twp., Fairfield Co. Robert Goslin.
1842. *Agastache nepetoides* (L.) Ktz. Catnip Giant-hyssop. Berne Twp., Fairfield Co. Robert Goslin.
1851. *Stachys palustris* L. Marsh Hedge-nettle. Liberty Twp., Wood Co. R. E. Shanks.
1867. *Monarda fistulosa* L. Wild Bergamot. Berne Twp., Fairfield Co. William Goslin.
1873. *Salvia lanceifolia* Poir. Lanceleaf Sage. North Union, Ross Co. Floyd Bartley and Leslie L. Pontius.
1880. *Plantago aristata* Mx. Large-bracted Plantain. Mill Twp., Tuscarawas Co. Irma Nelson.
1885. *Plantago virginica* L. Dwarf Plantain. Mill Twp., Tuscarawas Co. Irma Nelson.
1886. *Aralia spinosa* L. Angelica-tree. New Lexington, Perry Co. Walter Matz.
1887. *Aralia racemosa* L. American Spikenard. Plain Twp., Stark Co. Don M. Brown.
1889. *Aralia nudicaulis* L. Wild Sarsaparilla. Dover Twp., Tuscarawas Co. Irma Nelson.
1890. *Panax quinquefolium* L. Common Ginseng. Lawrence Twp., Tuscarawas Co. Don M. Brown.
1891. *Panax trifolium* L. Dwarf Ginseng. Plain Twp., Stark Co., and Lawrence Twp., Tuscarawas Co. Don M. Brown.
1896. *Sanicula marylandica* L. Black Snakeroot. Plain Twp., Stark Co. Don M. Brown. Damascus Twp., Henry Co., and Henry Twp., Wood Co. R. E. Shanks.
1901. *Torilis anthriscus* (L.) Gmel. Erect Hedge Parsley. New Vienna, Clinton Co. Katie M. Roads.
1902. *Deringa canadensis* (L.) Ktz. Homewort. Liberty Twp., Wood Co. R. E. Shanks. Berne Twp., Fairfield Co. William Goslin.
1903. *Chaerophyllum procumbens* (L.) Crantz. Spreading Chervil. Berne Twp., Fairfield Co. William Goslin.
1905. *Washingtonia longistylis* (Torr.) Britt. Long-styled Sweet-cicely. Wood Co. R. E. Shanks.

1914. *Heracleum lanatum* Mx. Cow-parsnip. Nimishellen Twp., Stark Co. Don M. Brown.
1916. *Angelica villosa* (Walt.) B. S. P. Hairy Angelica. Canton Twp., Stark Co. Dover Twp., Tuscarawas Co. Don M. Brown.
1918. *Oxypolis rigidus* (L.) Raf. Cowbane. Berne Twp., Fairfield Co. Robert and William Goslin.
1919. *Zizia aurea* (L.) Koch. Early Meadow-parsnip. Liberty Twp., Wood Co. R. E. Shanks. Highland Co. Katie M. Roads.
1920. *Zizia cordata* (Walt.) DC. Heartleaf Meadow Parsnip. New Market Twp., Highland Co. Katie M. Roads.
1921. *Taenidia integerrima* (L.) Drude. Yellow Pimpernel. Liberty Twp., Wood Co. R. E. Shanks.
1925. *Conium maculatum* L. Poison-hemlock. Chillicothe, Ross Co. Edward S. Thomas. Bellefontaine, Logan Co. A. G. Welshimer.
1926. *Sium cicutaefolium* Schrank. Water-parsnip. Berne Twp., Fairfield Co. Robert and William Goslin.
1927. *Aegopodium podograria* L. Goutweed. Bellefontaine, Logan Co. A. G. Welshimer.
1929. *Cicuta maculata* L. Spotted Water-hemlock. Liberty Twp., Wood Co. R. E. Shanks.
1934. *Erigenia bulbosa* (Mx.) Nutt. Harbinger-of-spring. Berne Twp., Fairfield Co. Robert Goslin.
1937. *Cornus asperifolia* Mx. Roughleaf Dogwood. Liberty Twp., Wood Co. R. E. Shanks.
1939. *Cornus femina* Mill. Panicled Dogwood. Liberty Twp., Wood Co. R. E. Shanks.
1943. *Nyssa sylvatica* Marsh. Tupelo. Harrison Twp., Henry Co. R. E. Shanks.
1952. *Mitchella repens* L. Partridge-berry. Dundee, Tuscarawas Co. Don M. Brown. Montgomery Twp., Wood Co. R. E. Shanks. Burton, Geauga Co. C. A. Dambach.
1954. *Diodia teres* Walt. Rough Buttonweed. Rose Twp., Carroll Co. Don M. Brown.
1956. *Galium boreale* L. Northern Bedstraw. Nimishellen Twp., Stark Co. Don M. Brown.
1958. *Galium circaezans* Mx. Wild Licorice. Harrison Twp., Henry Co., Liberty Twp., Wood Co. R. E. Shanks.
1959. *Galium lanceolatum* Torr. Lanceleaf Wild Licorice. Plain Twp., Stark Co. Don M. Brown.
1961. *Galium triflorum* Mx. Fragrant Bedstraw. Washington Twp., Henry Co. and Henry Twp., Wood Co. R. E. Shanks.
1962. *Galium mollugo* L. White Bedstraw. Prattsville, Vinton Co. Walter P. Porter.
1966. *Galium claytoni* Mx. Clayton's Bedstraw. Rowland's Pond, Athens Co. Walter P. Porter and P. S. Wamsley.
1967. *Galium trifidum* L. Small Bedstraw. Henry Twp., Wood Co. R. E. Shanks.
1972. *Viburnum acerifolium* L. Maple-leaf Arrow-wood. Harrison Twp., Henry Co. R. E. Shanks.
1980. *Vibernum cassinoides* L. Withe-rod. Canton Twp., Stark Co. Don M. Brown.
1981. *Viburnum lentago* L. Sheepberry. Henry Twp., Wood Co. R. E. Shanks.
1982. *Viburnum prunifolium* L. Black Haw. Monroe Twp., Henry Co. R. E. Shanks.
1986. *Triosteum perfoliatum* L. Common Horse-gentian. Dover Twp., Tuscarawas Co. Irma Nelson.
1997. *Lonicera glaucescens* Rydb. Glaucescent Honeysuckle. Henry Twp., Wood Co. R. E. Shanks.
2009. *Campanula americana* L. Tall Bellflower. Henry Twp., Wood Co. R. E. Shanks.
2014. *Specularia perfoliata* (L.) A. DC. Venus'-looking-glass. Liberty Twp., Wood Co. R. E. Shanks.
2015. *Lobelia cardinalis* L. Cardinal Lobelia. Washington Twp., Henry Co. R. E. Shanks.

2016. *Lobelia syphilitica* L. Blue Lobelia. Washington Twp., Henry Co. R. E. Shanks.
2019. *Lobelia inflata* L. Indian-tobacco. Bloom Twp., Wood Co. R. E. Shanks.
2021. *Lobelia spicata* Lam. Pale Spiked Lobelia. Plain Twp., Henry Co. R. E. Shanks.
2033. *Rudbeckia hirta* L. Black-eyed Susan. Berne Twp., Fairfield Co. William Goslin.
2043. *Helianthus microcephalis* T. & G. Small Wood Sunflower. Plain Twp., Stark Co., and Lawrence Twp., Tuscarawas Co. Don M. Brown.
2045. *Helianthus giganteus* L. Giant Sunflower. Washington Twp., Henry Co., and Plain Twp., Wood Co. R. E. Shanks. Jackson Twp., Stark Co. Don M. Brown.
2046. *Helianthus altissimus* L. Tall Sunflower. Sandy Twp., Stark Co. Don M. Brown.
2055. *Helianthus decapetalus* L. Thinleaf Sunflower. Union Twp., Logan Co. A. G. Welshimer.
2057. *Helianthus strumosus* L. Paleleaf Wood Sunflower. Plain Twp., Stark Co. Don M. Brown.
2076. *Bidens aristosa* (Mx.) Britt. Western Tickseed. Berne Twp., Fairfield Co. William Goslin.
2083. *Coreopsis tripteris* L. Tall Tickseed. Washington Twp., Henry Co. R. E. Shanks. Henley, Scioto Co. Katie M. Roads.
2087. *Polymnia uvedalia* L. Yellow Leaf-cup. Moonville, Vinton Co. Walter P. Porter and P. S. Wamsley.
2096. *Helenium autumnale* L. Common Sneezeweed. Damascus Twp., Henry Co. R. E. Shanks.
2097. *Helenium nudiflorum* Nutt. Purple-headed Sneezeweed. Goshen Twp., Tuscarawas Co. Irma Nelson.
2119. *Solidago squarrosa* Muhl. Stout Goldenrod. Waterloo Twp., Athens Co. Walter P. Porter and P. S. Wamsley.
2120. *Solidago bicolor* L. White Goldenrod. Canton, Stark Co. Don M. Brown.
2122. *Solidago flexicaulis* L. Zig-zag Goldenrod. Pleasant Twp., Fairfield Co. Robert and William Goslin. Brown Twp., Carroll Co. Don M. Brown.
2123. *Solidago caesia* L. Wreath Goldenrod. Richfield Twp., Henry Co. R. E. Shanks.
2129. *Solidago nemoralis* Ait. Gray Goldenrod. Washington Twp., Henry Co. R. E. Shanks.
2130. *Solidago canadensis* L. Canada Goldenrod. Berne Twp., Fairfield Co. Robert Goslin.
2131. *Solidago serotina* Ait. Late Goldenrod. Sandy Twp., Stark Co. Don M. Brown.
2134. *Solidago ulmifolia* Muhl. Elmleaf Goldenrod. Lawrence Twp., Tuscarawas Co. Don M. Brown.
2136. *Solidago neglecta* T. & G. Swamp Goldenrod. Harmon Twp., Clark Co. Helen Rea and E. S. Thomas.
2137. *Solidago juncea* Ait. Plume Goldenrod. Jackson Twp., Stark Co. Don M. Brown.
2141. *Euthamia graminifolia* (L.) Nutt. Bushy Fragrant Goldenrod. Berne Twp., Fairfield Co. Robert Goslin.
2145. *Sericocarpus asteroides* (L.) B. S. P. Toothed White-top Aster. Moonville, Vinton Co. Walter P. Porter and P. S. Wamsley.
2149.1. *Aster roscidus* Burgess. Dewy-leaf Aster. Oak Openings, Lucas Co. Floyd Bartley and Leslie L. Pontius.
2152. *Aster cordifolius* L. Common Blue Wood Aster. Plain Twp., Stark Co. Don M. Brown.
2153. *Aster lowrieanus* Port. Lowrie's Aster. Pike Twp., Stark Co. Don M. Brown.
2157. *Aster undulatus* L. Wavy-leaf Aster. Plain Twp., Stark Co. Don M. Brown.
2158. *Aster puniceus* L. Purple-stem Aster. Jackson Twp., Stark Co. Don M. Brown.
2160. *Aster novae-angliae* L. New England Aster. Berne Twp., Fairfield Co. Robert Goslin.

2163. *Aster prenanthoides* Muhl. Crooked-stem Aster. Berne Twp., Fairfield Co. Robert Goslin. Canton Twp., Stark Co. Don M. Brown.
2167. *Aster lateriflorus* (L.) Britt. Starved Aster. Plain Twp., Stark Co. Don M. Brown.
2168. *Aster hirsuticaulis* Lindl. Rough-stem Aster. Sandy Twp., Stark Co. Don M. Brown.
2170. *Aster multiflorus* Ait. Dense-flowered Aster. Canton Twp., Stark Co. Don M. Brown. Berne Twp., Fairfield Co. Robert Goslin.
2172. *Aster salicifolius* Lam. Willow Aster. Canton Twp., Stark Co. Don M. Brown.
2173. *Aster paniculatus* Lam. Panicled Aster. Rose Twp., Carroll Co. Don M. Brown.
2174. *Aster tradescanti* L. Tradescant's Aster. Sandy Twp., Stark Co. Don M. Brown. Greenfield Twp., Fairfield Co. Robert Goslin.
2178. *Erigeron pulchellus* Mx. Showy Fleabane. Jackson Twp., Stark Co. Don M. Brown.
2191. *Eupatorium sessilifolium* L. Upland Boneset. Canton Twp., Stark Co., and Lawrence Twp., Tuscarawas Co. Don M. Brown.
2210. *Anthemis arvensis* L. Field Dog-fennel. Jackson Twp., Stark Co. Don M. Brown.
2232. *Senecio obovatus* Muhl. Roundleaf Squaw-weed. Berne Twp., Fairfield Co. William Goslin.
2237. *Mesadenia atriplicifolia* (L.) Raf. Pale Indian-plantain. Washington Twp., Henry Co., and Plain Twp., Wood Co. R. E. Shanks.
2239. *Erechtites hieracifolia* (L.) Raf. Fireweed. Berne Twp., Fairfield Co. Robert and William Goslin.
2251. *Cirsium muticum* Mx. Swamp Thistle. Berne Twp., Fairfield Co. Robert Goslin. Washington Twp., Henry Co. R. E. Shanks.
2252. *Cirsium arvense* (L.) Scop. Canada Thistle. Athens Twp., Athens Co. Harold H. Moore.
2254. *Onopordon acanthium* L. Scotch Thistle. Edge of railroad tracks at Evergreen, Gallia Co. Clyde H. Jones.
2255. *Centaurea jacea* L. Brown Star-thistle. New Vienna, Clinton Co. Katie M. Roads.
2258. *Centaurea vochinensis* Bernh. Tyrol Star-thistle. Athens, Athens Co. R. Rypma.
2259. *Centaurea maculosa* Lam. Spotted Star-thistle. Ashland Co. H. M. Spandau. Plain Twp., Stark Co. Don M. Brown.
2266. *Cynthia virginica* (L.) D. Don. Virginia Cynthia. Moreland, Wayne Co. Don M. Brown. Berne Twp., Fairfield Co. William Goslin.
2273. *Tragopogon pratensis* L. Yellow Goat's-beard. Hocking Twp., Fairfield Co. Robert Goslin.
2274. *Tragopogon porrifolius* L. Salsify. Canton Twp., Stark Co. Don M. Brown.
2276. *Hieracium paniculatum* L. Panicled Hawkweed. Plain Twp., Stark Co. Don M. Brown.
2281. *Hieracium aurantiacum* L. Orange Hawkweed. Newark, Licking Co. Warren Abbott. Plain Twp., Stark Co. Don M. Brown.
2282. *Hieracium pratensis* Tausch. Field Hawkweed. Jackson Twp., Stark Co. Don M. Brown.
2284. *Hieracium venosum* L. Veined Hawkweed. Athens, Athens Co. Warren Abbott. Burton, Geauga Co. C. A. Dambach.
2292. *Nabalus altissimus* (L.) Hook. Tall Rattlesnake-root. Plain Twp., Wood Co. R. E. Shanks.
2299. *Sonchus asper* (L.) Hill. Spiny Sow-thistle. Berne Twp., Fairfield Co. Robert Goslin.
2302. *Lactuca spicata* (Lam.) Hitchc. Tall Blue Lettuce. Berne Twp., Fairfield Co. Robert Goslin.

BOOK NOTICES

Simplified Statistics for the Agronomist

A full description of statistical procedures for the analysis of field experiments, without recourse to algebra, but with ample arithemtical examples, all in 33 pages, is the remarkable achievement of this little pamphlet. It commences with a practical discussion of experimental error and soil heterogeneity and leads through the *t*-test to the analysis of variance. It describes in full the lay-out and analysis of randomized block, Latin square, factorial, split-plot, and quasi-factorial experiments. The simultaneous analysis of two or more variables or covariance methods are not included. Explanations of the statistical operations do not involve the mathematical theory nor do they treat generally of the problem of biological variation; they appeal rather to the agronomist's logic in terms of practical considerations known to the field worker. Hence, for the experimenter who wants only a working knowledge of the analysis of variance as applied to field trials, this publication would seem ideal.—*C. W. Cotterman.*

Field Trials: Their Lay-out and Statistical Analysis, by John Wishart. 36 pp. Imp. Bur. Plant Breeding and Genetics, Cambridge, Eng. 1940. Price 21c.

Animal Biology

Increase in knowledge may entail a change in concepts. Explanations which previously have been satisfactory, must often be revised in the light of new information. Textbooks especially must be kept as nearly abreast to information as possible. The textbook of zoology written by the late Professor Wolcott has recently been revised by his colleagues at the University of Nebraska. The organization of the first edition has been retained but many statements have been modified and new materials included. The work is well illustrated, sixty-four new illustrations have been added, approximately half of which are contained in the sections on reptiles and birds. A number of the illustrations used in the first edition have been improved. Except for the chapter on *Energy Changes in Organisms*, in which the concepts of oxidation within the organism are not handled in the light of modern physiological knowledge, the work is well done. This book designed as a text for a year's course in General Zoology, accompanied by laboratory, should be examined by those who wish to survey the animal kingdom.—*Paul E. Schaefer.*

Animal Biology, by Robert H. Wolcott. Second Edition, 649 pp., New York. The McGraw-Hill Book Company. 1940. $3.50.

A Century of Progress in Cellular Biology

Three interrelated topics of special interest to the cytologist and geneticist comprise the first volume of *Biological Symposia*, which were read at the 1938 meetings of the A. A. A. S. and are here presented in book form. The three symposia are titled: I. The Cell Theory, Its Past, Present and Future; II. Mating Types and Their Interactions in the Ciliate Infusoria; and III. Chromosome Structure. The volume itself is attractively printed. It contains contributions by 16 American biologists and will serve, on the biologist's bookshelf, to commemorate the centenary of the cell theory, even though, as shown by two symposium papers, the celebration must be regarded as somewhat overdue.

Though related, the three symposia differ greatly in the character of the papers which they contain. An interested outsider, desirous of studying the personality of the biologist, would find this book an excellent portrayal in three characteristic moods. The symposium on Cell Theory shows the biologist as a philosopher, somewhat exasperated by the immensity of his problem, carefully evaluating his past achievements, and using the full ponderosity of his language while describing his present difficulties. Following an introduction by Mayer and an historical review of microscopy by Woodruff are two very similar chapters by Karling and Conklin. These authors unite in taking from Schleiden and Schwann most of the credit commonly accorded them as founders of the cell theory. The next three papers by

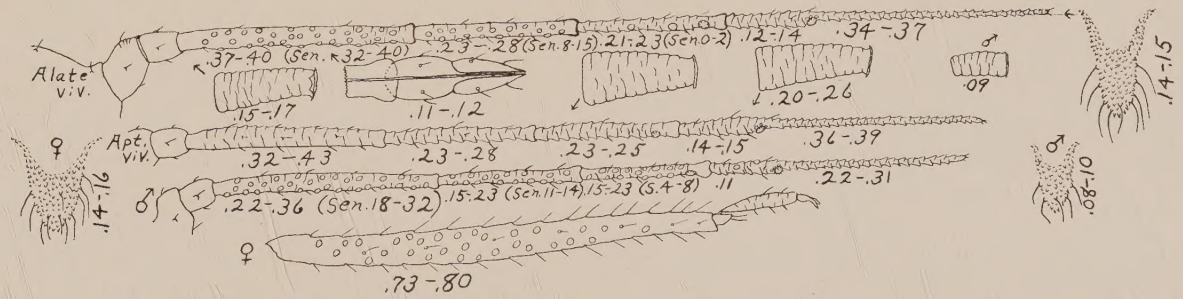
Baitsell, Schrader, and Weiss deal in turn with cells as structural units, mitotic machines, and as individuals in development. Prof. McClung concludes with a discussion of the future. Collectively, these last four essays tell a great deal about what is not known at present about life.

Quite a different sort of biologist is revealed in the second symposium, wherein a surge of new discoveries on mating reactions in the ciliate Infusoria are reported by five enthusiastic protozoologists. This section is "refreshing reading," to quote Dr. A. F. Blakeslee, who inscribes the Foreward to the book. "One feels as if one were in the laboratory with the workers, seeing the results coming thick and fast and trying to figure out how they fit into a broad picture, what their relation may be to sex, to self-sterility and incompatibilities in higher forms." This symposium deals with discoveries dating from 1937. A wide array of new facts are reported which might be summarized by saying that much of the former confusion about the problems of conjugation and exdomixis in the Protozoa has been largely removed by the discovery of hereditary mating "types" and "groups" comparable to multiple sexes and mutually intersterile subspecies in higher organisms. Also of interest are the facts that different species vary greatly in their mating systems, that, in certain cases, Mendelian segregation and mutation are exhibited, and that, like hereditary traits in general, the mating reactions are also influenced by a variety of environmental factors. This symposium would seem to hold a great deal of interest to many different kinds of biologists because of the many parallelisms.

The last symposium on Chromosome Structure is the shortest of the three and reflects a steadier, perhaps more normal, state of growth in biological theory. In the first paper "On Coiling in Chromosomes," Dr. Nebel gives a good explanation of current theories and adds one of his own which is quite ingenious and well illustrated by photographs of models but which seems to require quite a few new assumptions to meet the shortcomings of alternative theories. A very informative paper by Waddington deals with recent discoveries in the chemistry and physics of chromosomes. Dr. Painter, rediscoverer of the giant salivary chromosomes of Diptera, reaffirms their multiple-chromonema nature by ontogenetic studies, and Dr. Demerec closes the symposium with a review of chromosome structure in the light of gene physiology.—*C. W. Cotterman.*

Biological Symposia, Volume I, edited by Jaques Cattell. 238 pp. Lancaster, Pa., The Jaques Cattell Press. 1940.

The cut opposite was inadvertently left out of the article "Notes on Some Ohio Aphids" by Clyde F. Smith in the May number of the Ohio Journal of Science.



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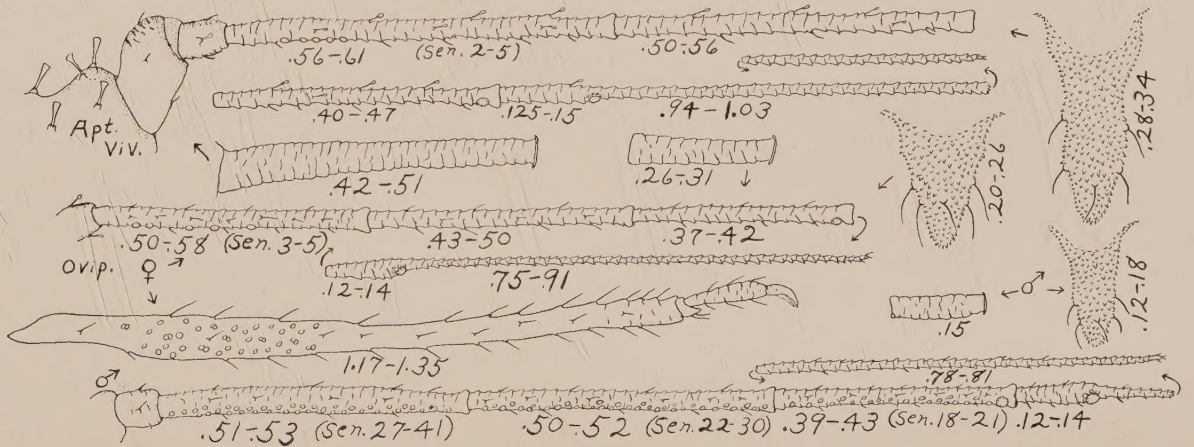

CAPITOPHOPUS OHIOENSIS